1984 ANNUAL REPORT FROM THE WATER BUDGET MANAGERS

To

THE NORTHWEST POWER PLANNING COUNCIL

AND

BONNEVILLE POWER ADMINISTRATION

1984

ANNUAL REPORT

FROM

THE WATER BUDGET MANAGERS

This report is to fulfill the annual Water BUDGET Center reporting requirements to the Northwest Power Planning Council under its Columbia River Basin Fish and Wildlife Program, and the annual reporting requirements to the Bonneville Power Administration under its funding contracts Which supported this work.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1984 ANNUAL REPOERT FROM THE WATER BUDGET MANAGERS

I. INTRODUCTION

The Water Budget Center (WBC) was created in April of 1983 as a result of the provisions of Section 308 of the Fish and Wildlife Program (Program) developed by the Northwest Power Planning Council (Council). In fulfilling its obligation under the Northwest Power Planning and Conservation Act of 1980, to "protect, mitigate and enhance" the fish and wildlife resources of the Columbia Basin, the Council recognized the necessity for inclusion of the needs of migrating salmonids in the planning and operation of the hydroelectric system. A cornerstone of the Program was the creation of the Water Budget: a volume of water set aside for management by the state and Federal fishery agencies and Columbia Basin Indian tribes for enhancement of the spring salmonid outmigration.

Specifically, the Council allocated a total volume of 78 kcfs-months, divided into volumes of 58 kcfs-months in the mid-Columbia, and 20 kcfs-months in the Snake. This volume is available for management by the agencies and tribes during the April 15-June 15 period. Section 300 of the Program also contains provisions for monitoring the entire smolt outmigration, and for research to refine the management and scope of the Water Budget and to investigate' measures necessary to increase the migrant survival of fish outside the Water Budget period.

To manage the Water Budget, the Program provided for two Water Budget Managers, one representing the interests of the state and Federal fishery agencies, and the other for the Columbia Basin Indian tribes. The two managers, along with their associated staff, comprise the Water Budget Center.

In addition to direct management of the Water Budget during the April 15-June 15 period, the Water Budget Center directs the Smolt Monitoring and Water Budget Evaluation Program (Section 304 (d)). The fishery agencies and tribes also authorized the Water Budget Center to coordinate agency and tribal system operational requests throughout the year and to manage spill for fish passage.

This document constitutes the second annual report from the Water Budget Manager in compliance with Section 304(c)(3)(amended) of the Fish and Wildlife Program. The report covers 1984, the first year of full operation of the Water Budget. It contains a summary of the 1984 flow conditions, Water Budget management, and flow shaping to meet the needs of the smolt outmigration. In addition, a summary of activities conducted under the Smolt Monitoring Program is provided, as is preliminary data on the timing and duration of the smolt outmigration as required by Section 304(C)(3)(B). A detailed annual report of the activities of the Water Budget Center, including complete data for the Smolt Monitoring Program is planned for completion by February 1, 1985.

II. OPERATIONAL GUIDANCE

Actions of the Water Budget Center reflect the policies and priorities of the state and Federal fishery agencies and Columbia Basin Indian tribes. Guidance of the Water Budget Center is through the Fish Passage Committee of the Columbia Basin Fish and Wildlife Council and the Columbia giver Inter-Tribal Fish Commission.

Each year the agencies and tribes prepare the Detailed Fishery Operating Plan (DFOP). This is the primary policy do-t guiding actions by the Water Budget Center. The DFOP details agency and tribal policies on all actions relating to fish pasaage including fish bypass guidelines, dates of operation for fish passage facilities, and detailed operating criteria for adult and juvenile fish facilities.

Utilizing agency and tribal policy, and the program outlined in Section 300 of the Fish and Wildlife Program, the Water Budget Center annually prepares the Water budget Measures Program. This is submitted to the Bonneville Power Administration for funding of the program. The Water Budget Measures Program also delineates the duties and responsibilities of the Water Budget Center in coordinating agency and tribal actions regarding dounstream fish passage.

III. 1984 RUNOFF

A. RUNOFF VOLMES

The 26year period of 1961 through 1980 recently was adopted by the Columbia Basin Water Management Group as the basis for determining the average January through July (Jan-Jul) seasonal runoff. Other comparisons commonly in use are with the shorter term 15 years of 1963-1977 or 1970-198;, a..d the longer term SO years of 1929-78. Listed below are the averages in million acre-feet (MAF) *for* Jan-Jul runoff above The Dalles for each of these different periods *of* record, and the actual observed 1984 runoff.[1]

Ave. Jan-Jul Runoff Above The Dalles, MAF

1961-80 (20 yrs.)	1963-77 (15 yrs.)	1970-84 (15 yrs.)	1929-78 (50 yrs.)	1984 Preliminary
107.0	109.6	110.5	102.7	119.1

The preliminary estimate of the 1984 actual Jan-Jul runoff above The Dalles was 111% of the 1961-80 (20-year) average. Runoff above Grand Coulee contributing to the 1984 Jan-Jul total was 52.2 MAF (92% of the 20-year average). Above Lover Granite the contributing Jan-Jul runoff **was** 43.9 MAF (146% of the 20-year average).

[1] Provisional data from **NWS** Runoff Forecast Center

The Water Management Group designates the April 1 forecast each year as the "official" Jan-Jul runoff forecast for the year. The 1984 official forecasts and comparisons with actual Jan-Jul runoff vere as follows:

	April 1 forecast	% of actual
The Dalles	102.0 MAF	86
Grand Coulee	56.9 MAF	108
Lower Grauite	33.1 MAF	7s

The April 1 forecast anticipated total runoff at The Dalles to be considerably less than actually occurred, and even less (95%) than the 20-year average. This forecast also was for more mid-Columbia runoff than took place, and much less Snake Diver runoff than actually observed in 1984.

The April 1 forecasts are used for pre-season planning for Water budget management during the spring smolt outmigration.

B. RUNOFF TIMING

Runoff timing in 1984 for the Snake, mid-Golumbia, and lower Columbia is illustrated by Figures 1, 2, and 3, respectively. These figures compare each month's runoff volume at the location Indicated for the Jan-Jul period in the following manner:

-1984 regulated runoff volume for the month, which is the volume that actually occurred as a result of upstream storage regulation;

1984 Lower Granite Runoff Timing

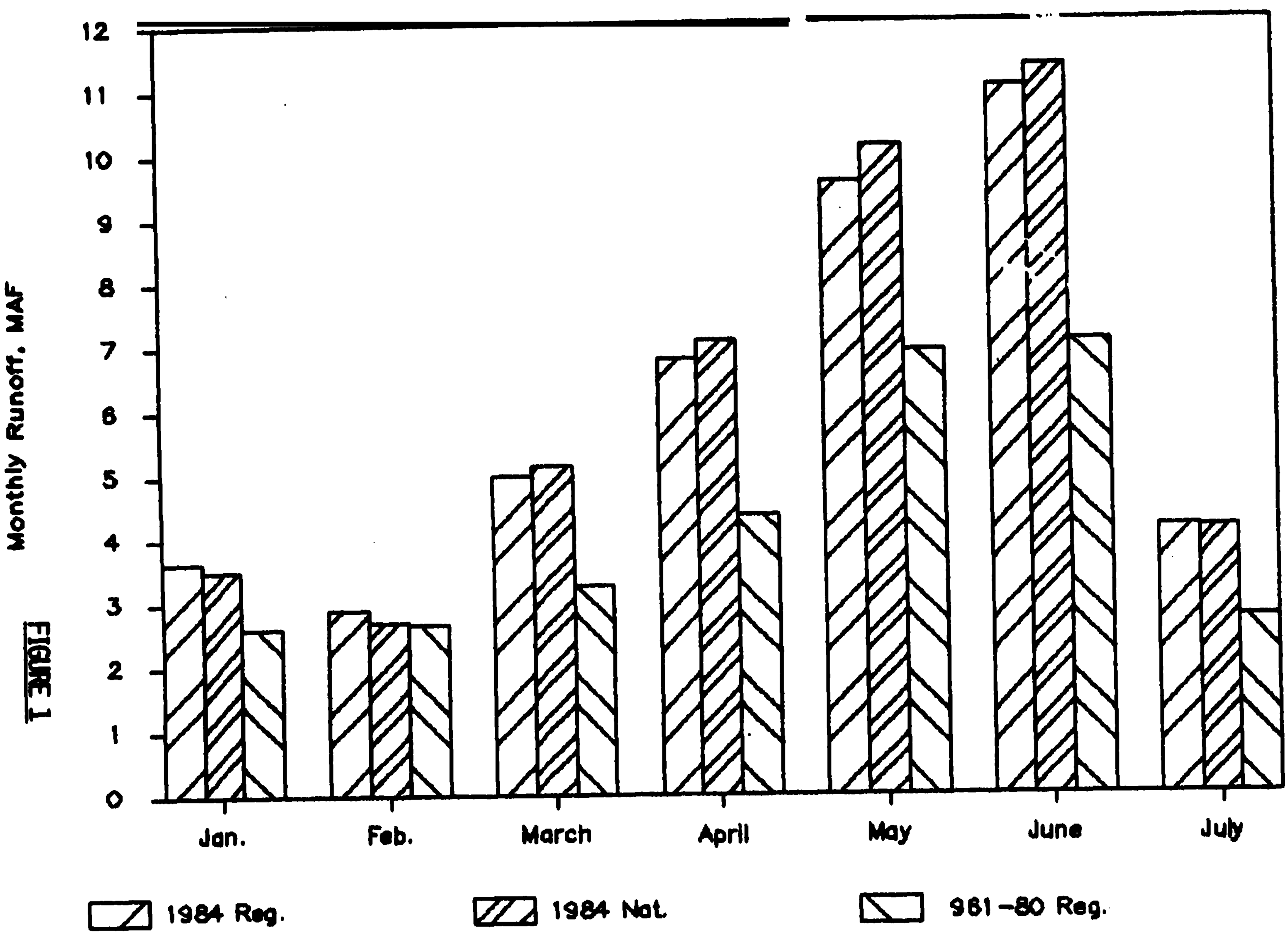

FIGURE 1

-1984 natural runoff volume for the mouth, which is the volume that would have occurred without upstream storage regulation, as estimated by the Depletions Task Force of the Columbia giver Water Management Group;
-20-year regulated runoff volums for the month, which is the average volume for 1961-80, also adjusted by the Depletions Task Force to provide an estimate of the actual runoff volume that would have occurred with a 1984 level of upstream storage regulation.

Snake giver natural runoff at lower Granite was considerably above the 20-year average throughout the spring migration period. This eliminated any need for a Water Budget from Snake giver storage. (It should be noted that under the existing agreement between the Water Budget managers, the CoE, and Idaho Power Company, there was no available water budget in the Snake giver because of the high runoff volume.)

The small amount of storage available to regulate Snake giver runoff--3 MAF--compared to the 1984 Jan-Jul runoff volume-43.9 MAF--is the reason for the relatively close proximity of each month's "regulated" and "natural" runoff volumes; This illustrates the fact that the magnitude and timing of uncontrolled Snake giver runoff largely dictate the resulting streamflows in the higher runoff years.

In contrast, the more than 40 MAF of available storage control above Priest Rapids Dam can greatly influence runoff timing at that location (Figure 2). At Lover Granite 65 percent of the runoff is uncontrolled, while at Priest Rapids only 8 percent of the runoff is uncontrolled. 1984 monthly runoff volumes at Priest Rapids vere nearly leveled out

1984 Priest Rapids Runoff Timing

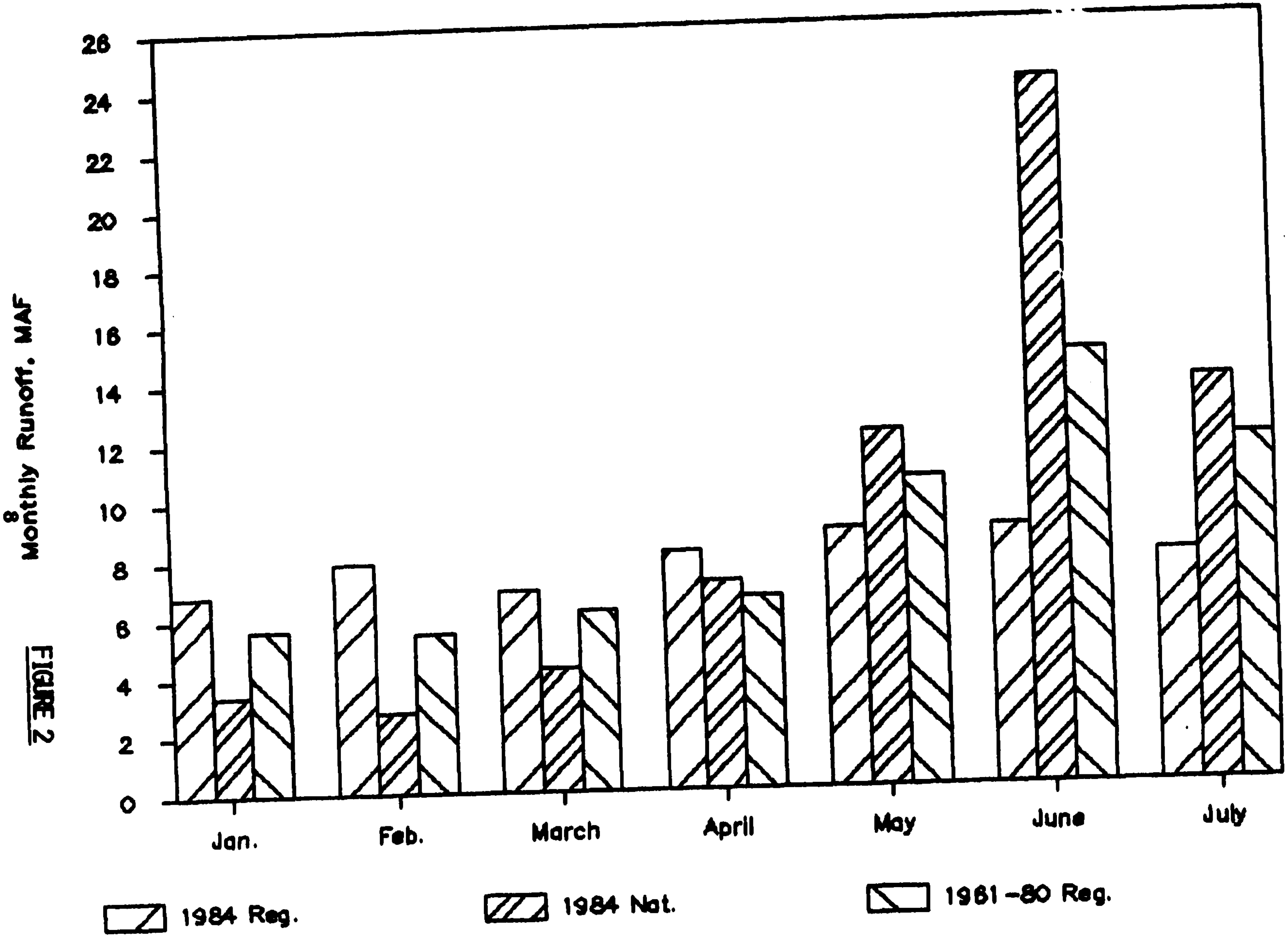

FIGURE 2

during the Jan-Jul period by upstream regulation. This resulted in runoff much greater in the early months and much less in the later months than would naturally occur.

Runoff timing at The Dalles (Figure 3), being a composite of mid-Columbia and Snake giver runoff, reflects many of the characteristics already discussed. For example, the effect of upstream storage regulation is evident, as is the seasonally high runoff contribution from the Snake, combined with the unusually low mid-Columbia natural runoff in my.

1984 The Dalles Runoff Timing

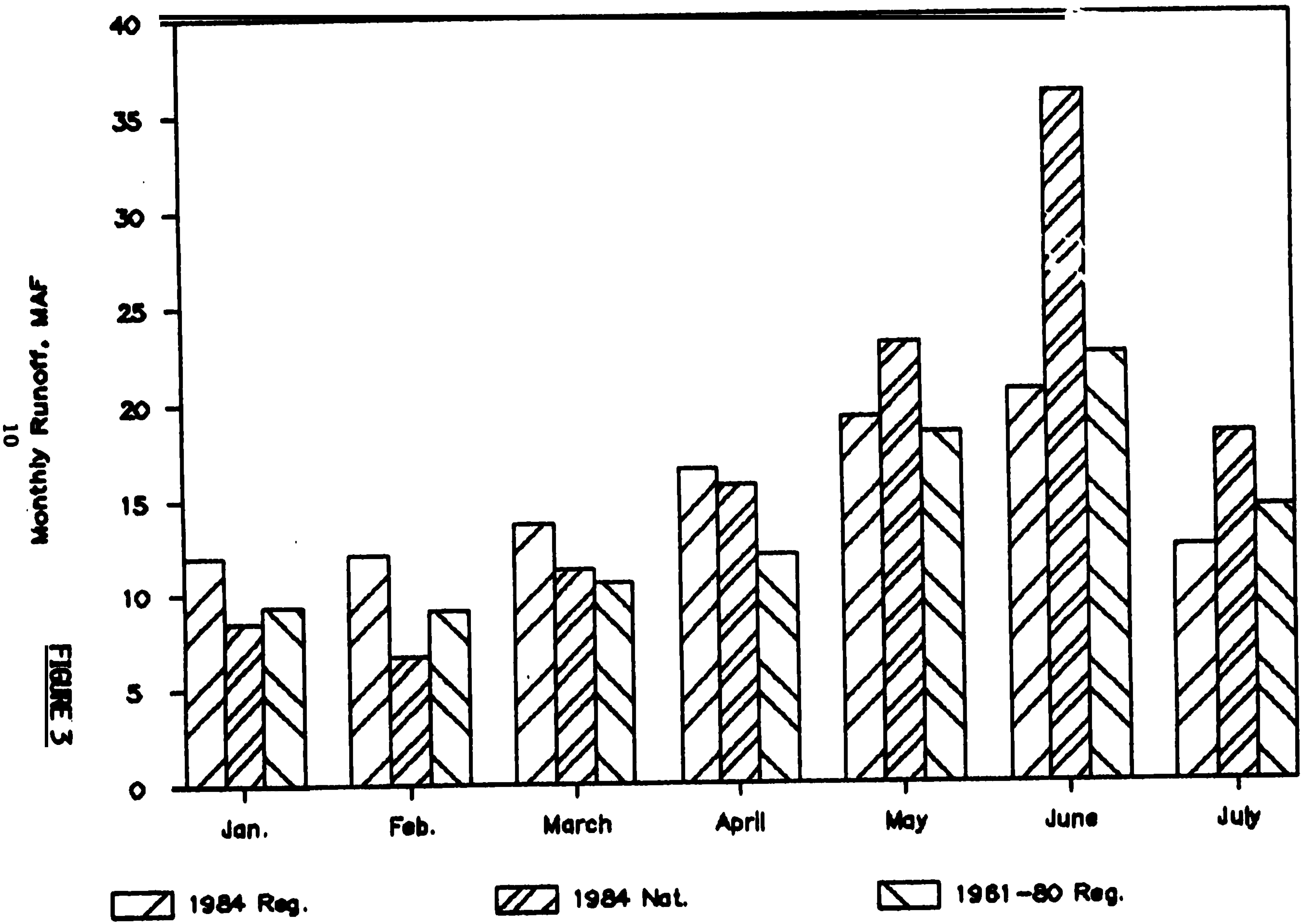

FIGURE 3

IV. 1984 OPERATIONS

A. WATER BUDGET USAGE

1. Snake River (measured at Lower Granite Dam)

The unusually large Snake River runoff and high level of sustained flow during the spring season, described above, eliminated the need to exercise the Lower Granite Water Budget in 1984.

Daily flow and spill levels at Lower Granite Dam in 1984 are illustrated in Figure 4, starting on March 1 and continuing through the April 15 - June 15 Water Budget period. Flows were above the minimum specified by the fishery agencies and tribes for juvenile fish migration throughout the period. Flows vere near or above the specified optimum for all but the first two weeks of May. The result vas favorable runoff conditions for 1984 juvenile fish migration in the Snake River.

Had Snake River runoff been below average in 1984, the interim plan for providing a portion of the Water Budget would have been utilized. In this interim plan, the CoE has agreed to provide the volume of water from Dworshak identified as "shapeable by Water Budget Managers" in Figure 5. This volume, determined from the April 1 runoff forecast at Lower Granite, can be called upon by the Water Budget managers between April 15 and June 15 at any flow rate within Dworshak outflow capabilities, including spill, until the volume total has been reached. When the April-July runoff forecast is greater than 23 MAP, there is no Water Budget from Dworshak. A runoff forecast of greater than 23 MAF presently has a probability of occurrence of approximately 25% or one in four

1984 Lower Granite Dam Operation

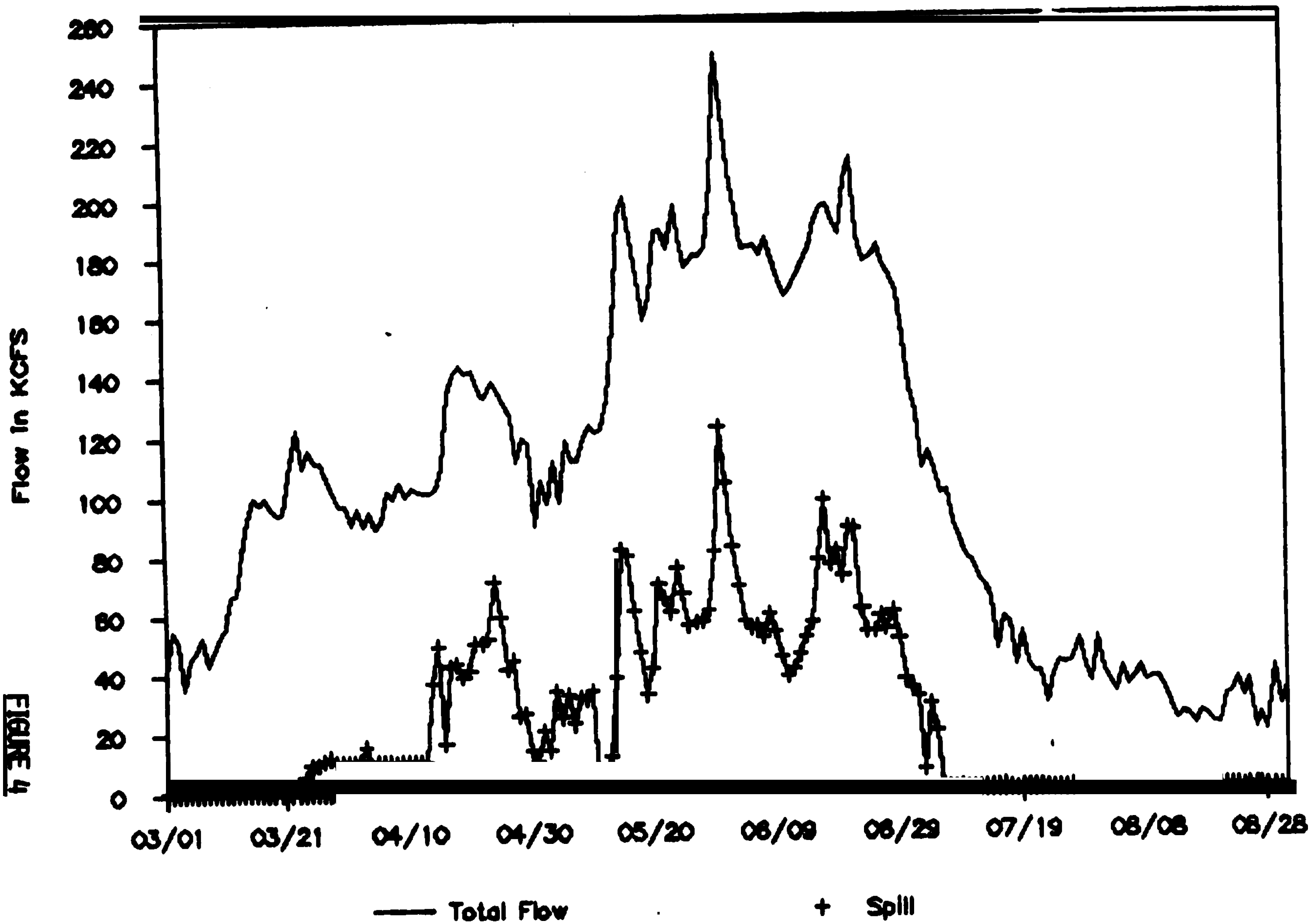

FIGURE 4

Dworshak Water Budget

April 1 Forecast

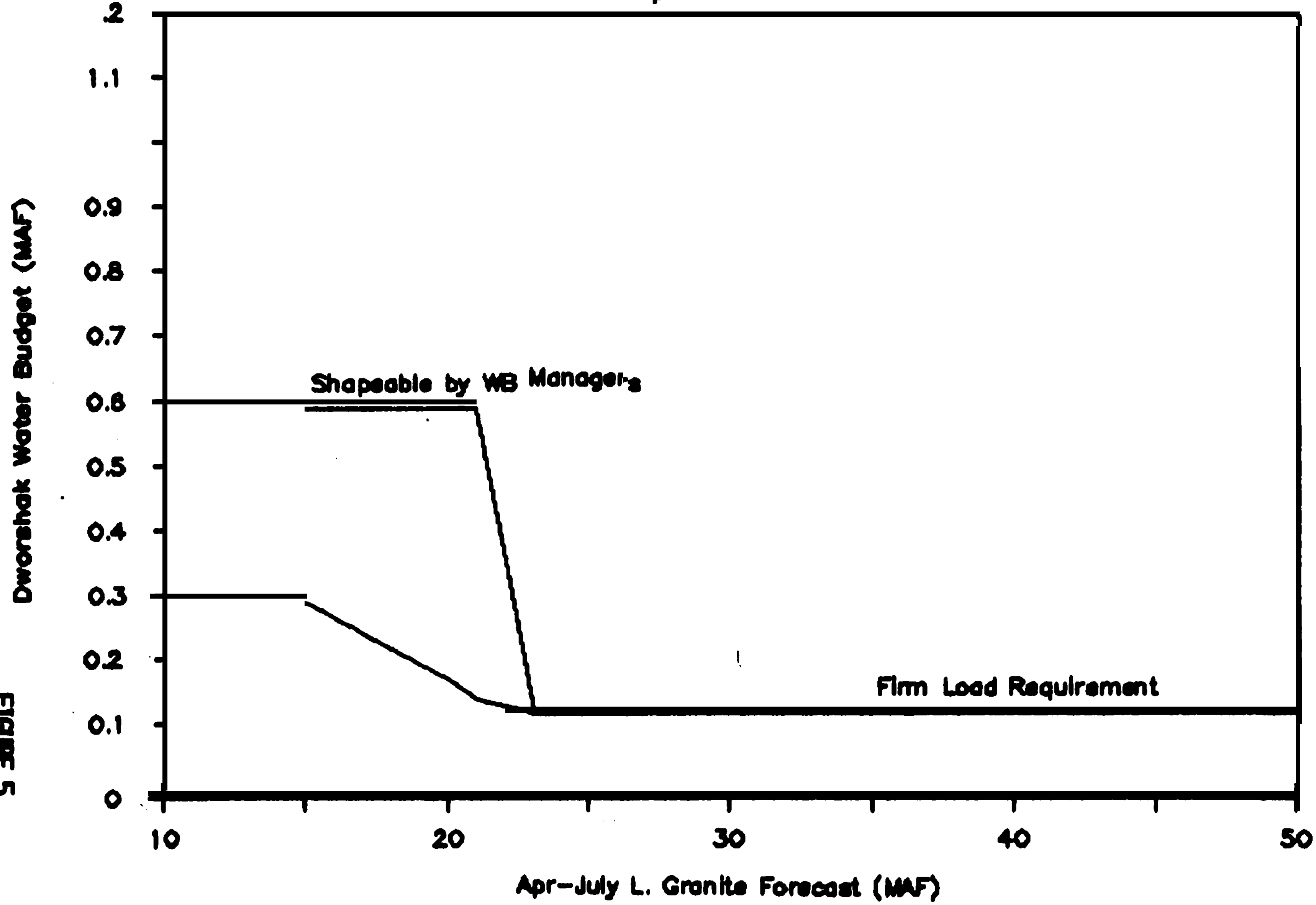

FIGURE 5

years. When the forecast is less than 23 MAF, some of the storage volume is allocated for use by the Water Budget Managers. For example, when the forecast is for 15 MAF at Lower Granite, 0.3 MAF of storage is "shapeable" for Water Budget purposes and 0.3 MAF is "required" for firm power requirements (Figure 5).

In addition, Idaho Power Company (IPC) has tentatively agreed to draft Brownlee during May to an elevation predetermined by the April 1 runoff forecast for the Snake River measured at Brownlee Dam. This is to assist flow augmentation up to 85,000 cfs at Lover Granite providing what at least 10,000 cfs is simultaneously being released *at* Dworshak. IPC is also retaining the option to not provide any Water Budget if they estimate that refill of their system would in any way be jeopardized. The Water 8udget managers can use the resulting volume at any flow rate up to the hydraulic capacity at Oxbow Dam. Oxbow Dam has the lowest hydraulic capacity of the three IPC projects on the Snake River. Keeping flows at or below 27,600 cfs at Oxbow saves IPC from spilling any energy.

The combined contribution from Dworshsk and Brounlee under this arrangement falls considerably short of providing the Snake River Water Budget allocation specified in the Fish and Wildlife Program in years with less than 23 MAF Apr-Jul runoff. There is some question as to the adequacy of the Water Budget in years above 23 MAP also. We can say though that given the existing interim agreement in the Snake River, the Water Budget as specified in the Fish and Wildlife Program will not be met in years vith a forecasted runoff of 23 MAP or less at Lower Granite.

Prior to the Fish and Wildlife Program, base case studies with no Water Budget flows for fish shoved that during the month of May flows needed for fish migration were only expected to be met approximately 60% of the time. During the remaining 40%, expected flows averaged around 70 kcfs with the lowest monthly average being approximately 56 kcfs (CoE hydro study BASEFOUR). After piecing together the tentative commitments referred to above from the CoE and IPC, we may expect to meet the Water Budget about 73% of the time. This represents an increase in probability of occurrence of minimum flow (85 kcfs) of 13% over pre-Fish and Wildlife Program operations. During the remaining 27%, the lowest average monthly flow would be approximately 67 kcfs. Although 73% probability of occurrence is not the measure of Water Budget stated in the program, the Water Budget managers have agreed to study this plan. To come closer to achieving the stated Water Budget, an additional 10 kcfs-months from storage during dry years would have to be provided. By adding an additional 10 kcfs in the dry years, compliance with the Program Water Budget would increase to about 90%. During the remaining 10%, the average flow would be approximately 81 kcfs, with the lowest flow being 77 kcfs.

Evaluations currently are underway by the CoE, and others, of the potential for additional Snake River flow augmentation through modified flood control and refill operations at Dworshak and construction of the Weiser storage site, in combination with flow shaping by Idaho Power Company and use of presently uncontracted irrigation storage in upstream reservoirs. The Northwest Pover Planning Council in its amended Fish and Wildlife Program is requiring both the CoE and the Bureau of Reclaration to provide periodic reports on the status of these actions.

2. Mid-Columbia (measured at Priest Bapids Dam)

Most attention prior to the 1984 spring migration season had been centered on the problems of providing adequate Snake River flows for migrating juveniles because of an erroneous assumption by all parties that there should be little difficulty in providing mid-Columbia flows except in the most critical low runoff years. Problems and difficulties encountered with Priest Rapids Water Budget management in 1984, a rear-average runoff year, were unanticipated.

The intent of Water Budget management in the mid-Columbia during 1984 was to maintain flows above the fishery agency and tribal minimum level at Priest Rapids (130 kcfs) by filling in the "valleys" when natural and power flows together would be less than the minimumns. Since the Water Budget volume is extremely limited, such rationing is the only way that minimum flows can be insured for the majority of the outmigration. As it was. despite the fact that this was an above average flow year, sufficient Water Budget was available only to cover the period April 28 to June 2.

Mid-Columbia Water Budget management in 1984 is illustrated in Figure 6, which displays forecasted flows for the period, Water Budget requests, and the resulting flows. The BPA forecast information is provided as an indication of what flows would have occurred without intervention by the Water Budget Managers. Forecasts are provided to the Water Budget

1984 Priest Rapids Water Budget

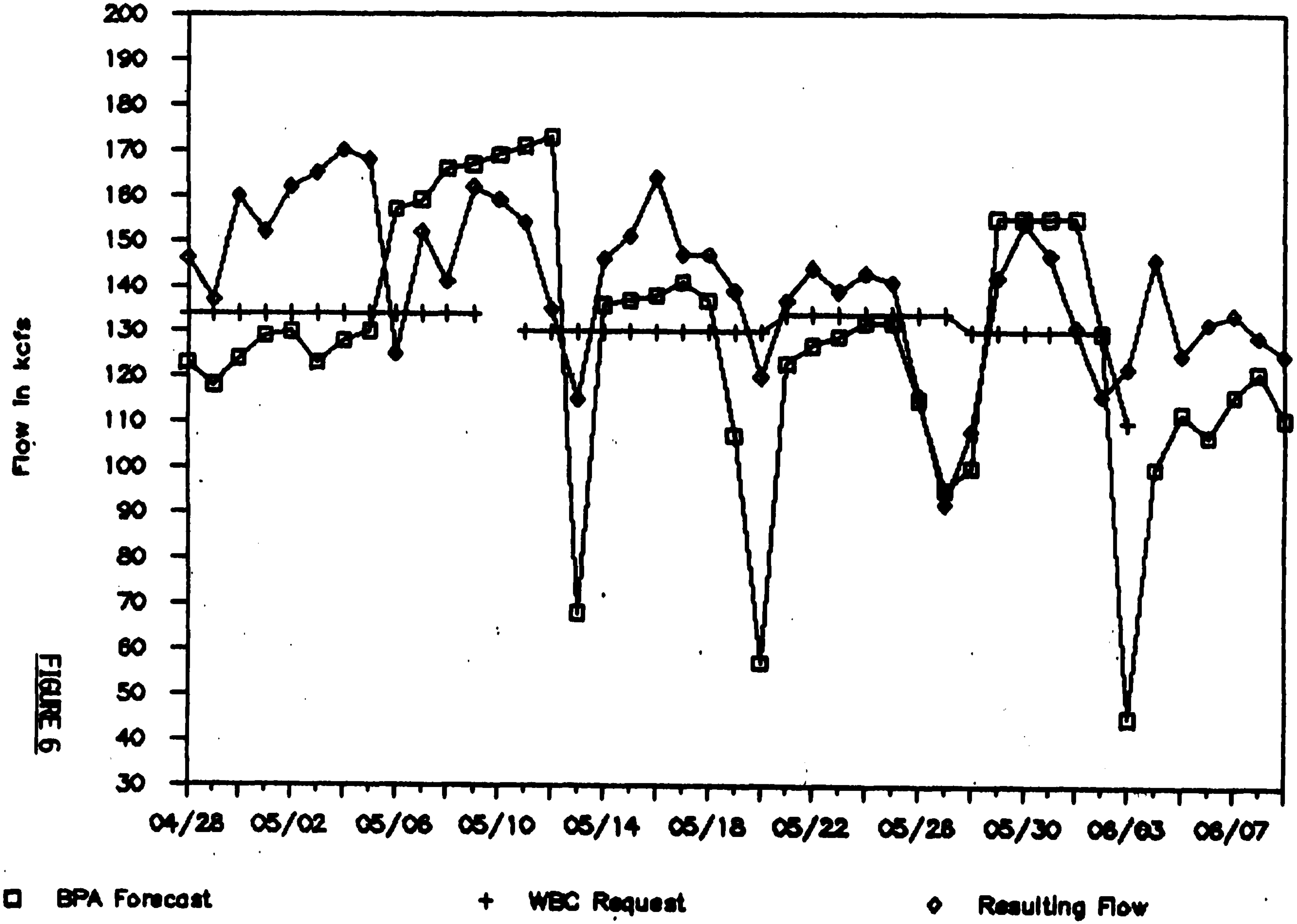

FIGURE 6

Managers by BPA on Tuesday morning for the following Sunday through Saturday period, and contain projected flows to meet load and do not include use of the Water Budget.[2]

For moat of the Water Budget period, requests were based on the fore-casted flows and the currant status of the fish migration. However, requests during the period May 11 through May 20 reflect an offer made by CoE in which the Water Budget would be released at the continuous rate of 30,000 cfs beginning May 11 and continuing through the end of the season This volume vaa to ride on top of power flows, but vould only be accounted for at the rate of 30,000 cfs per day. In agreeing to this arrangement, the Water Budget managers specified a minimum flow of 130 kcfs. Based on available CoE and BPA forecasts, it appeared that flows through the mid-Columbia under this scenario would easily exceed this level. However, the arrangement failed soon after implementation, due to problems encountered by BPA when cool weather reduced natural runoff. After May 20, management returned to the practice of short term requests reflecting forecasted flows. Subsequent Water Budget requests were aimed at maintaining flows above the 138 kcfs level during the peak spring chinook and steelhead migration period.

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[2] An exception to this occurred early in the season when BPA forecasts did included projected Water Budget use. This required the asmumption on BPA's part that, once started, the Water Budget vould continue until exhausted Once this misconception was corrected, forecasts did not include the Water Budget. This problem should not affect conclusions drawn on Figure 6.

Figure 6 also illustrates the actual implementation of the Water Budget requests by the CoE. On several veekends during the peak of the migratlon, particularly over Memorial Day weekend, flovs dipped far below the minimum despite Water Budget requests to cover these periods. In the absence of any other explanation by the Corps of Engineers, it can only be concluded that these modifications of the Water Budget Managers' request resulted from the CoE's decision to shape flows to meet the available secondary energy sales market, rather than to conform to the priorities stated in the Fish and Wildlife Program, section 304(a)(8).

B. SPILL MANAGEMENT

1. General

The magnitude and distribution of spill at individual projects and among projects affects juvenile and adult fish passage and dissolved gas levels. Water Budget Center operations during 1984 gave considerable attention to spill management in order to provide the best possible fish passage conditions.

Simultaneously providing for juvenile passage, adult passage, and dissolved gas control required almost daily spill distribution adjustments both at and among projects during this Water Budget period. High flows and low loads resulted in large amounts of forced spill in the hydro system primarily in the Snake River and at McNary Dam., Spill distribution patterns at a project differs for adults and juveniles.

For example, daytime spill will be spread across the spillway in a manner to enhance adult passage at ladder entrances. During nighttime hours when, at most projects, the bulk of the juveniles are passing, conceatrated flow in spill bays closest to the powerhouse may be asked for. During the highest flovs, control of dissolved gas can take precedence. Usually this means that spill will remain in the pattern used for passing adults.

Spill for fish paaaage requests were made in accordance with the DFOP to insure that sufficient spill was provided for juvenile passage at Tadividual projects and that spill was distributed at specific projects to enhance juvenile and adult passage. Spill priority requests were made to distribute flovs occurring as spill in excess of the system needs for power and fish passage. Spill patterns associated with spill requests are provided in the DFOP for specified distribution among spill bays at individual projects in order to maintain good passage conditions for both adults and juveniles.

Spill was the most effective, and in some cases the only means, of smolt passage that avoided turbine mortalities at John Day, Lover Monumental, Priest Rapids, Wanapum, Rocky Reach, Rock Island and Wells, Spill also was used to augment the inadequate bypasses at Binneville, The Dalles, Ice Harbor, Little Goose and Lower Granite.

Spill requests at collector dams (Lower Granite, Little Goose, and McNary) vere based on transportation guidelines negotiated by the agencies and tribes with the CoE, and fishery agency and tribal policy.

In general, these guidelines called for bypass of smolts to be emphasized during the spring chinook migration period, and smolt transportation to be emphasized during the steelhead and fall chinook-migration periods. This policy reflected the lack of demonstrated benefit of transportation for spring chinook, and the positive benefit effect of transportation on returns of steelhead and probably fall chinook (Park et al., 1983).

Spill was requested at all projects except McNary during the spring chinook migration to mazimize bypass. After the bulk of the spring chinook had passsd, spill vas restricted to maximize the collection of downstream migrants in the powerhouse collection systsm. At Lower Granite and Little Goose, good timing separation occurred between spring chnook and steelhead (Table 6), and spill was minimized to enhance transportation beginning on May 10 and May 12 respectively (cf. Figure 8). Spring Chinook and steelhead migrations overlappsd at McNary (cf. Figures 12 and 13) and transportation vas emphasized once subyearling chinook dominated the migration (May 29). High flows resulted in forced spill after these dates and throughout much of the spring migration period at all three projects.

Disposition of fish collected -In the powerhouse bypass system during the spring chinook migration period varied at each project. At Lower granite, all collected fish, including spring chinook were transported. At Little Goose, mechanical separation of spring chinook from steelhead was attempted, and separated chinook were bypasssd. separation of spring chinook from the other components of the collection occurred also at McNary. The transportation guidelines called for no more than 10% of the spring chinook passage at McNary to be transported. Mechanical separation was short of this goal, but high spill levels, which directed many fish away from the powerhouse, enabled the criteria to be achieved.

2. Spill Requests vs Spill Provided

On a number of occasions and at different locations, the CoE modified Water Budget Center spill requests either in magnitude or duration, or both, from the amount requested. The CoE provided no rationale for these modifications. The CoE's unilateral decision making process regarding spill is evidenced by the 1984 spill plan which has not been acceptad by the fishery agencies and tribes. This highlights the problems created by the CoE during the 1984 season on those occasions vhere they rejected the biological rationale for spill requests presented by the fishery agencies and tribes on the basis of CoE's independent biological assessmsnt. In the opinion of the Water Budget Managers, the CoE should restrict their participation in spill decisions to other operational criteria such as flood control, navigation, irrigation and recreation, and the effect of tribal and fishery agency requests on these considerations. BPA has stated that the very nature of secondary energy sales makes them interruptible to provide spill for fish passage.

Spill for fish passage must remain separate from flows. Providing adequate bypass conditions at each project is an obligation of the CoE separats from the obligation to provide adequate flows system-wide as provided for In the Water Budget. Until those projects with either no bypass facilities or inadequate facilities are brought up to acceptable standards, spill for fish passage rust be provided regardless of flow levels.

The CoE did not operate in this manner in 1984. In early May when flood control and power flows appeared to provide close to optimum flows, Water Budget requests vere terminated to conserve the Water Budget for later in the month when flows were forecasted to be substantially-below recommended minimum flows. Upon notification of this action by the Water Budget managers, the CoE stated that since flows were being reduced by stopping the Water Budget, spill for fish passage would be decreased. To avoid an immediate problem for the fish, the Water Budget was restarted. This action violated the principle of separation of Water Budget flows from spill for fish passage.

Of special concern to the fishery agencies and tribes was the termination of both smolt monitoring and spill for fish passage at John Day Dam on August 31, 1984. This action by the Corps, without fishery agency and tribal coordination, took place when relatively large numbers of juvenile fish were present at John Day. The CoE reasoning for this action was apparently that daily passage of 38,888 salmonids (the agreed upon threshold) could no longer be documented since CoE hydroacoustic and BPA funded agency monitoring ended on August 31. Both the fishery agency and tribal 1984 Detailed Fishery Operating Plan and the Corps 1984 Spill Plan recognized the need to provide spill at John Day under these circumstances.

V. 1984 SMOLT MONITORING PROGRAM

The Smolt Monitoring Program originates from section 304(d)(2) of the Fish and Wildlife Program: "Bonneville shall fund an annual smolt monitoring program to be conducted by the fish and wildlife agencies and tribes...[which]...will provide information on the migrating characteristics of the various stocks of salmon and steelhead within the Columbia Basin." In response to this section, the agencies and tribes developed a program to monitor the annual smolt outmigration for all important salmonid stocks, and to derive indices for characterization of the outmigration. The program has the objectives of providing information for in-season management of the Water Budget and other system operations, and to determine indices of smolt survival, travel time, and other migrational characteristics. The program is under the direction of the Water Budget Center with specific tasks subcontracted to various agencies and organizations.

Data collected as part of the 1984 Smolt Monitoring Program is still preliminary and continues to be analyzed at the present time. This report will be confined to a description of the field activities conducted in 1984, and the approach taken in analysis of the data. Complete data reporting and analysis will occur in the annual report of the Smolt Monitoring Program.

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In 1984 the Smolt Monitoring Program provided important in-season data for the Water Budget and other system operations management, and developed indices of migrational characteristics for spring, summer, and fall chinook and steelhead in the Snake and mid-Columbia reaches.

A. IN-SEASON MANAGEMENT

In-season management data was gathered at several sites throughout the basin and communicated to the Water Budget Center via telephone. Data consisted of daily indices of fish movement, as well as brand recovery at most sites. In-season monitoring sites are listed in Table 1.

Table 1. Water Budget Center smot monitoring sites, 1984.

Site	Method	Data Gathered
	mid-Columbia	
Wells Dam	Purse seine	Brands
Wells Dam	Hydroacoustics	Migration Index
Rock island	Bypass Trap	Brands, species
Priest Rapids	Gatewell Dip	Brands species
	Snake River	
Whitebird Trap	Scoop Trap	brands, species
Snake River Trap	Dipper Trap	Brnads, species
Clearwater Trap	Scoop Trap	brands, species
Lower Granite	Bypass/Collection	Brands species
	Lower Columbia	
McNary	Bypass/Collection	Brands, specie8
John Day	Airlift Pump	brands specie8

Additional in-season data was obtained from the CoE CROHMS data system. This Included adult counts, flow, spill and other project operational data.

All of these data were gathered daily for use by the Water Budget Center staff in making operational decisions, and were published in a weekly report distributed to interested persons and agencies.

B. MIGRATIONAL CHARACTERISTICS

Determination of migrational characteristics is au important aspect of the smolt Monitoring Program. Migrational characteristic8 include travel time, duration and timing of migration, and survival. Such data permits the comparison of the success of the annual outmigration between years from which the overall succsss of all in-river passage efforts can be judged. Additionally, monitoring data can provide insight from which to generate hypotheses for testing in research programs.

1. Migration timing and duration.T and duration of the smolt outmigration was determined by calculating when 10% 50% and 90% of the migration, by species, passed hey recovery sites. These data vere recovered from the observed sample for sites such as the Snake River Trap, and from what is termed here a "migration index" at Lower Granite and mcNary Dam. The migration index is the estimated daily collection in the bypass/collection system divided by the proportion of river flow passing through the powerhouse on the same day. This procedure was used to compensate for the change in the proportion of the migration intercepted by the submerged traveling screen bypass system as a result of fluctuating powerhouse operations. Migration indices of this sort were also used to determine travel time for mark groups.

2. Travel Time. In 1984, the program gathered indices of travel time for marked hatchery groups in the Snake and mid-Columbia reaches. Future programs will utilize these same groups to facilitate year to year comparisons.

Travel time was determined by marking fish in hatcheries in the Snake and mid-Columbia using standard freeze branding techniques. Fish were released either at the hatcheries or at off-site locations. Hatcheries, numbers marked, and release sites are listed on Table 2.

Table 2. Fish mark data for travel time monitoring in 1984.

Hatchery	Species	Numbers Marked	Release Site
		Snake River	
Rapid River	Spring Chinook	85,664	Dells Canyon
Rapid river	Spring chinook	23,840	Rapid River
McCall	Spring Chinook	33,934	Sawtooth Hatchery
McCall	Summer Chinook	25,555	SF salmon
Hagerman	Steelhead	21,146	Decker Flat
Hagerman	Steelhead	22,236	Decker Flat
Niagara Spgs.	steelhead	21,623	hells Canyon
Dworshak	Steelhad	19,969	Dworshak
		mid-Columbia	
Winthrop	Spring Chinook	20,319	Winthrop
Wells	Summer Chinook	101,653	Wells
Priest Rapids	Fall chinook	80,500	Priest Rapids
Naches	Steelhead	49,269	-Naches River

Travel time was also recorded in the mid-Columbia for steelhead released is part of the survival monitoring program.

Observations of brand passage were recorded at the sites listed in Table 1. In addition to telephoning data to the Water Budget Center daily for In-season management, the data was sent to the NMFS/CZES Burroughs computer in Seattle, where the data was entered Onto the NMFS data base, checked for errors, and archived for future analysis.

Indices of smolt travel time in the Snake River were determined as the average travel time for the mark group between lower Granite and McNary Dam. This reach was chosen Since both Of these sites have good sampling programs, they almost bracket the lower snake reach, and lower Granite is sufficiently below the release points for initial hatchery mortalities to have occurred so that the index more nearly represents travel time as influenced by mainstem flow conditions Statistical error (standard deviation) was also calculated for the index, permitting statistical comparison between years.

In the mid-Columbia, travel time indices were calculated as the average travel time from the release point of the mark group to McNary, Dam. This is considerably less desirable than the snake River indices since the release points are often in tributaries which introduces another component into the calculated travel time However, this arrangement is necessary at the present time because no suitable sample site exists in the upper end of the mid-Columbia.

3. <u>Survival</u>. To insure the statistical integrity of the smolt survival monitoring program, the Water Budget Center assembled a group

of fishery scientists and biometricians[3] to study the available techniques for determining smolt survival, and Identify the pros and cons of each. The group also studied the equations appropriate to calculating variance associated with a survival estimate, and determined estimates of sample sizes and sampling rates needed to achieve various levels of statistical confidence. Results of the group's work to date are summarized in McKenzie et al. (1984).

For the mid-Columbia survival was determined using the indirect method (McKenzie et al., 1984). In this procedure, survival is calculated as the ratio in proportions recovered at McNary Dam in marked experimental and control releases. The experimental releases occurred at the top of the reach at Pateros and the control releases at the bottom of the reach below Priest Rapids Dam. Dam to limited fish availability, the program in 1984 could only encompass survival for steelhead from Wells Hatchery.

The biometrician group found that at present there is no satisfactory method for determining survival through the entire lower-Snake because of transportation removals at Lover Granite and Little Goose. This is because the number released initially must be corrected for the proportion that are transported. This cannot be done without a knowledge of the survival from release point to transportation point. A more

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[3]Members of the group were: Lyle Calvin (OSU), Chuck Junge (ODFU), Frank Ossiander (NDFS), Dan McKenzie (Battelle NW), and Chip McConnaha w=).

complete diScuSSiOn of this problem is found in the appendix to ths 1984 Water Budget Measures Program and in McKenzie et al. (1984).

Survival could not be determined through the lower Columbia because of the lack of a good mark recovery facility at Bonneville Dam.

To determine survival of Wells steelhead in 1984, two replicate experimental and control groups were freeze branded at the hatchery. Numbers marked and release points are listed in Table 3. Although the experi mantal design called for three replicates, sufficient fish were available for only two replicates.

Table 3. **Numbers** of fish marked and release points for steelhead smolt **survival monitoring program, 1984.**

Group	No. Marked	Release Point
Experimental No. 1	32,193	pateros
Control No.1	12,163	below priest
Experimental No.2	31,335	patros
Control No. 2	12,191	below priest

C. 1994 DATA COMUNICATIONS NETWORK

1. Description

The Water Budget Center Data Communication Network provide8 centralized collection, analysis, and storage of data used in implementing the Water Budget Measures program. In the future, a central source of fish migrational data will be provided to which other parties can have ready access.

The Water Budget Program has two primary data processing requirements. The first involves in-season management, and requires quick access to real-time (preliminary) data. The second component is the analyis Of the smot outmigration and evaluation of the Water Budget which requires verified data. These two types of data, termed respectively "soft" data and "hard" data, are obtained through the Water budget smolt Monitoring Program and from outside sources such as the CoE, Fish and Wildlife Agencies, PUD's, and Tribes.

Soft data includes information on juvenile and adult migration, runoff and flow conditions, dam operations, and dissolved gas levels. Current information is accessed daily and used in managing the operation of:

a) the Water Budget,

b) spill for upstream and downstream migration,

c) spill distribution for nitrogen abatement, and

d) project facilities for upstrecn migrating adults.

This information is al80 incorporated into weekly reports; these report8 summarize the Water Budget Center activities and present factors affecting Water budget Center decisions on system operations.

Hard data consists of verified and edited smolt monitoring data, flow and dam operation8 data, and freeze brand release information. These data are used in the analysis of smolt migration and the evaluation of the Water Budget.

2. 1984 Program

During 1984, Soft data was obtained from five sources. 1) smolt monitoring **data** was collected at the remote sample sites and reported daily over the **telephone** to the Water **Budget** Center. 2). Smolt transportation data was provided to the Water Budget Center by the Fishery Transportation and Oversight Team (PTOT) on a Weekly basis. 3) A Hewlett Packard. (HP) microcomputer was used to access the CoE CROHMS data network; CROHMS report8 on adult counts, river flow, powerhouse flow, spill, and dissloved gas were obtained daily. 4) Runoff and streamflow forecasts, resident on the CROHMS network and BPA's CDC computer, were also accessed with the HP microcomputer. 5) Information on hatchery releases (pre-season schedules, within sesason schedule updates, and verified release data) was obtained from the fish and wildlife agencies and tribes through the mail and from telephone contacts.

The hard data was compiled with the NMFS/CZES data analysis system for monitoring smolt **migration** (Giogi et. al 1984). This analysis system was modified for use by the Water Budget Center and maintained on the

NMFS Burroughs computer in Seattle. Date collected at the remote smolt monitoring sites was **mailed** weekly to Seattle for incorporation into the analysis system. flow and dam operation8 data for John Day, McNary, and Lower Granite were obtained from CoE on a weekly basis. This flow information was used in conjunction with collection efficiency povehouse discharge regression models (Sims et al., 1984) to expand steelhead and yearling chinook counts to an index of passage. Informatior. on the release of freeze brand8 was entered onto the Burroughs computer and wed to validate brand recapture data. The NMFS/CZES smolt analysis program8 were used to perform data entry, error checking, editing validation of brand recaptures, and summariazation of smolt monitoring data. Data files used for the NMFS/CZES analysis system were converted to a format conducive for archiving and analyis with the new Water Budget Center computer system.

D. COORDINATION OF HATCHERY RELEASES

The Water Budget Center has the responsibility of planning for spill and flow management relative to fish migrational needs in the Columbia River Basin. Coordinating hatchery releases to correspond to optimal passage condition8 is and important task if juvenile fish survival is to be increased. Conversely, Water Budget managemnet and other system operations must reflect the biological necessities of the outmigration.

Prior to-the juvenile outmigration, a list of proposed hatchery release8 above Bonneville Dam was compiled. The Water Budget Center then contacted hatchery release coordinstore of hatchery managers on a weekly basis to keep track of actual fish release and report projected releases throughout the migration season. Totals of hatchery releases were reported in the Water Budget Center weekly report. Close contact with hatcheries enabled the Water Budget managers to make flow and operations management decisions based on fish releases and their subsequent arrival at mainstem dams.

The Water Budget Center coordination with agencies included notification of when migrating conditions might be optimal, when Water Budget flows were available, (April 15June 15), or when juvenile bypass facilities are operable. Hatchery release dates and details were worked out by each agency with some flexibility built in to allow earlier or later releases based on special needs e.g. IDFG only had fish trucks available to transport Its spring chinook from Rapid river Hatchery to Hells Canyon prior to the anticipated release date. Therefore, Hells Canyon releases were partially set by logistical requirements In other cases, fish were released early because of their "readiness" to migrate from the hatchery ponds. In another instance a group of spring chinook at Ringold Hatchery was released in March because fall chinook would be placed in the same ponds that the spring chinook occupied, At times, surplus fish were released early to reduce hatchery densities and feed requirements

During 1981, Federal and state fish hatcheries released approximately 74 million yearling and subyearling salmon and steelhead into tributaries of the Columbia river above Bonneville Da. Table 4 is a preliminary list of hatchry releases by species and river area from 1982-84.

Table 4. SUMMARY OF FISH RELEASES SPECIES AND RELEASE AREA FROM 1982 TO 1984*

1984

River Area	Spring Chinook[1]	Summer Chinook	Fall Chinook Brights	Fall Chinook Tule	Coho	Steelhead	Total
Snake R.	8,701,[illegible]06	356,673[1]	427,191	0	0	173,970	15,659,440
Mid-Col. R.	6,350,[illegible]08	240,865	14,878,076	0	517,100	[illegible]492,400	24,478,549
Lower Col. R.	6,800,[illegible]07	0	3,463,191	20,773,294	2,566,534	534,124	34,137,550
TOTAL	21,852,[illegible]21	1.597,538	18,768,458	20,773,294	3,083,634	8,200,494	74,275,539

1983

River Area	Spring Chinook	Summer Chinook	Fall Chinook Brights	Fall Chinook Tule	Coho	Steelhead	Total
Snake R.	5,626,000	264,000	115,000	0	0	3,475,000	9,480,000
Mid-Col. R.	4,369,017	1,608,798	12,537,557	0	535,029	1,235,000	20,285,401
Lower Col. R.	4,743,230	0	2,370,249	21,200,000	5,385,004	447,000	34,145,483
TOTAL	14,738,247	1,872,798	15,022,806	21,200,000	5,920,033	5,157,000	63,910,884

1982

River Area	Spring Chinook	Summer Chinook	Fall Chinook Brights	Fall Chinook Tule	Coho	Steelhead	Total
Snake R.	2,657,000	148,000	900,000	0	0	5,300,000	9,005,000
Mid-Col. R.	5,354,641	2,713,266	6,297,241	0	482,510	1,115,000	15,962,658
Lower Col. R.	5,556,645	0	0	21,200,000	4,603,437	352,[illegible]	31,712,082
TOTAL	13,568,286	2,861,266	7,197,241	21,200,000	5.085,947	6.767,000	56,679,740

*1984 data are preliminary; 1982 and 1983 Tule Fall Chinook numbers are estimated.
[1] Includes 1983 brood year releases of spring and summer chinook.

VI. ADULT FISHWAY INSPECTIONS

A. DESCRIPTION

Adult fish continually migrate up the Colnmbia River system to reach natal spawning grounds Many of these fish must pass from one to nine maninstem hydroelectric dams. Since attraction and fish ladder flows make up a small part of the total river flow, it is essential that migrating adults find fish ladder entrances with little delay. basic operating criteria have been developed over the years by state, federal and tribal agencies which result in good passage conditins. The Water Budget Center serves as the coordinator for adult passage facilities inspections for the federal hydroelectric system, and maintains records of passage conditions at non-federal projects.

Inspections of fish passage facilities are done by state and federal fishery agency personnel on a regular or sometimes unscheduled basis. Inspections insure that upstream fish passage criteria are being adhered to and fish are not being delayed. These inspections allow fihsery agencies the opportunity to wet with project operations personnel and discuss areas of concern and potential problems inspection report8 were reviewed by the Water Budget Center staff and Federal project operator8 were contacted if adjustments were requirded

The surveillance team members also made on-site inspections of fingerling bypa systems to insure that they were operating in criteria. Juvenile passage facilities vary fromnonexistent at some project8 to complex systems with latest equipment and designs. In some cases such as where transportation of juvenile salmonids occur, there is 24 hours per day surveillance by project and state personnel. At these dams, contact is made with state and project fish biologists to ensure that the facilities have been and are operating according to criteria.

B. 1984 SUMMARY

1. Conditions. The overall movement of upstream migrants in 1984 appeared to be satisfactory with few delays except for summer steelhead from Bonneville to upriver projects. Generally these delays occur annually when temperatures begin rising in late July. Special efforts were made by fishery agencies and Corps personnel to check on potential problems which appeared to exist at The Dalles and John Day Dams this year. However, adult passage facilities were operating in criteria, and fish may have been delayed by temperature or other factors.

Some CoE and PUD projects were operating at less than full criteria as seen during inspections by fishery agencies this year. It appears that, during periods of low tailwater, certain projects have difficulty maintaining proper head at main fishway entrances. Main entrance gates bottom-out and water depth over these weirs are not up to criteria. Also it was noted that auxiliary water pumps were not being run at a rate to achieve the desired amount of water for attracting fish to the fish ladders and maintaining proper head at main fishway entrances.

The Corps of Engineers and PUD's are aware of these system shortcomings. Additional details of fishway inspections will be available when the annual report is completed in February. The projects are becoming more aware of their responsibilities to keep fish passage facilities operating in criteria. The PUD's and CoE have fishway inspections by project personnel on a frequent basis (at least once a day).

2. Adult Run Size. Returns of steelhead, sockeye and bright fall chinook over Bonneville set recent records. Adult spring chinook return8 continued to be low and turned downward after several years of modest gain. Summer chinook returns, although still at extremely depressed levels, increased slightly this year and stopped the annual decline in return8 which began in 1978. Adult returns in 1984 through October 28 are listed in Table 5 and are compared to recent returns.

Table 5. A comparison of Columbia River fish counts at Bonneville, McNary, Ice harbor, and priest Rapids Dams for calendar years 1984, 1983 and the 10 year average (1974-83).

	1984 2/	1983	10 year average
Summer Steelhead 1/			
Bonneville	314,162	217,541	140,754
McNary	131,779	123,988	57,344
Ice Harbor	91,889	87,508	38,787
Priest Rapids	25,619	31,682	9,544
Spring Ch4&--			
Bonneville	51,139	56,838	93,906
McNary	27,474	31,636	38,584
Ice Harbor	9,070	12,602	22,276
Priest Rapids	12,653	10,800	12,879
S ?mer Chinook			
Bonneville	28,407	23,458	38,748
McNary	21,202	16,199	25,090
Ice harbor	6,453	4,922	6,801
Priest Rapids	15,390	9,608	16,936
Fall Chinook (Mult Count)			
Bonneville	146,971	113,300	154,020
McNary	61,913	48,700	31,990
Ice Harbor	1,624	1,800	1,427
Priest Rapids	10,242	8,200	5,530
Coho (Adult Count)			
Bonneville	17,128	8,400	26,940
McNary	887	790	2,720
Ice Harbor	18	220	
Priest Rapids	122	310	488
Sockeye			
Bonneville	152,543	100,476	58,213
McNary	56,837	40,849	36,479
Ice Harbor	103	200	223
Priest Rapids	104,831	89,808	51,322

1/ Steelhead counts from June 1 - October 31
2/ 1984 counts thru October 28 and are preliminary data.

VII. PRELIMINARY 1984 SMOLT MIGRATIONAL DATA

A. SMOLT OUTMIGRATION ESTIMATE. Section 304 (c)(3)(B) of the Fish and Wildlife Program requests the WB Managers to report "A record of the estimated number of smolts which passed Lover Granite and Priest Rapids dams,...". At present, however, no reliable method exists for estimating the size of the smolt outmigration at either of these points.

In past years, an estimate of the size of the spring chinook and steelhead population at Lower Granite was made using the relationship between powerhouse flow propotion, and the collection efficiency of the bypass system. These relationships were developed by Sims et al. (1984) by recording the proportion of marked groups of fish collected by the bypass collection system at various powerhouse operatioas. The spring chinook population at Lover Granite was estimated by this method at 3.9 million in 1983, 2.1 million in 1982, and 3.2 million in 1981. Similarly, steelhead passage at Lower Granite was estimated at 2.9 million, 4.3 million, and 3.7 million in 1983, 1982, and 1981 respectively (Delarm et al., 1984).

These methods, however, do not appear to be applicable to Lover Granite in 1984, apparently due to changes in the fish guidance efficiency (FGE) of the submerged traveling screen bypa system. Krcms (NMFS, personal communication) found that the FGE in 1984 was appreciably less than that measured in previous years. There is presently no confirmed explanation for this change in FGE. Since the use of the flow/collection efficiency relationships of Sims et al. depends on an historical data base, a significant change in the 1984 conditions from those in the base period can be expected to affect the population estimates.

This is demonstrated when the estimated population size at Lover Granite is compared to the total Snake River fish transported at Lover Granite and Little Goose combined, and is especially evident for steelhead. Using the flow/collection efficiency relationships, the 1984 spring chinook population at Lover Granite is provisionally estimated at 3.89 mlllion, and the steelhead population at 2.79 million. These numbers are unexpectedly low considering that steelhead and especially spring chinook hatchery releases in the Snake system in 1984 were appreciably greater than in past years (Table 4). Total fish transported from Lover Granite and Little Goose combined in 1984 was 1.31 million and 2.73 million for spring chinook and steelhead respectively (preliminary compilation from FTOT data, Koski, NMFS, personal communication). Of the total estimated population of fish approaching Lover Granite, 34% of the spring chinook were transported, and 98% of the steelhead. The percentage of spring chinook transported is high considering the amount of spill which occurred during the migration period; obviously the percentage for steelhead is unrealistically high as well. For steelhead this means that 40% of the population vas collected and transported from Lover Granite, and 96% of the remaining population was collected and transported from Little Goose. In light of the past performance of the collection system8 and the quantity of spill which occurred in 1984 during the spring chinook and steelhead outmigration periods, these results are not possible, and invaldate the population estimates.

It is possible to make an estimate of the Snake River outmigration at Little Goose by applying the flow/collection efficiency relationships developed for Lover Granite. Using the known number of fish removed for transportation and the probable magnitude of mortalities, an estimate of the population at Lover Granite could be made. Indications are that PGE and other condition8 at Little Goose were normal in 1984. Any estimate developed in this manner must, however, be used with caution due to the evident problem involved in using a relationship developed at another project. Since the project design and forebay configuratiOn at Little Goose and Lover Granite are very similar, such a procedure &es have some merit, particularly in light of the lack of alternative methods for estimation of the size of the outmigration. Due to the involved analysis of the flow and powerhouse relationships necessary to make this estimate, no figure can be reported at **this** time, but should he available in the near future.

For Priest Rapids, no methodology presently exists for estimating the size of the smolt outmigration, except subtraction of an estimate of the Snake giver migration at McNary from the total estimated migration past McNary. Since this involves adjusting the estimated little Goose population for presumed mortalities between Little Goose and McNary, the resulting estimate can liberally be termed rough. In any event this must await the estimation Of the Little Goose population.

The size of the spring chinook and steelhead outmigration can be estimated at Mary. Techniques for this estimation are similar to those described above for Lower Granite, and were developed **by Sims** et al.

(1984). Since no change in FGE or other conditions were observed this year at McNary relative to the base period, these techniques are applicable. Using this method, the 1984 spring chinook outmigration past McNary is provisionally estimated at 5.1 million, and the steelhead outmigration at 1.9 million. In comparison, spring chinook passage at McNary in 1982 and 1983 was estimated to be 3.7 and 3.8 million respectively, and steelhead passage was estimated at 1.7 and 1.5 million (DeLarm et al., 1984).

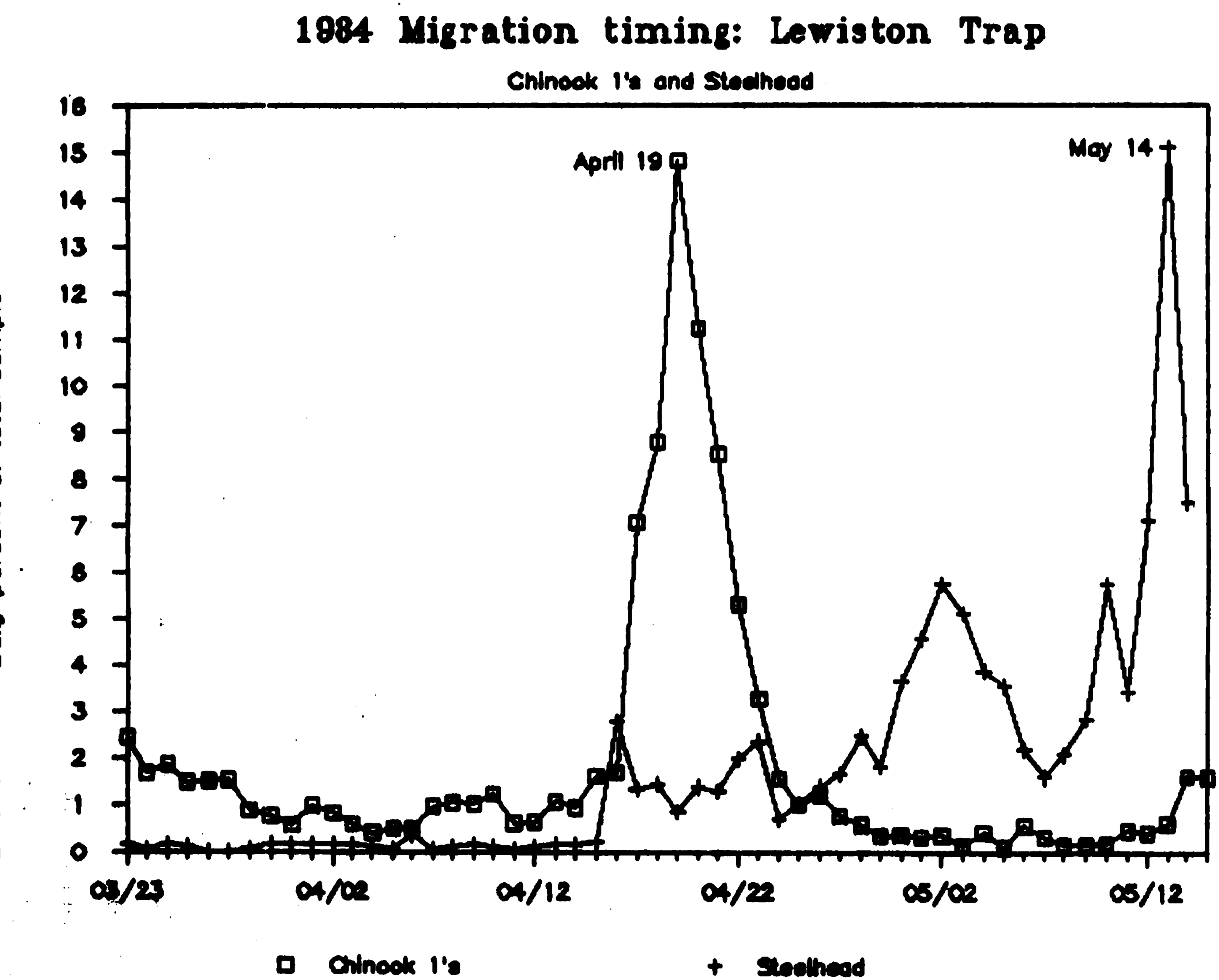
B. SMOLT ARRIVAL TIME AND DURATION OF MIGRATION. In the Snake River, migration into the lower Snake hydroelectric system is first signaled by 8 ~pling at the lewsiton Trap (Snake River) and Clearwater Traps. The Clearwater Trap, however, did not operate satisfactorily for the entire season and was not useful for characterization of the outmigration, although Important early season management information was provided. These traps were operated by the Idaho Departrent of Fish and Game. Technique8 are generally described in Scully et. al (1983).

1. Lewiston Trap

Dally sample at the Lewiston Trap as a percent of the total sample is shown in Figure 7 for spring chinook and steelhead. Sampling began on March 23 and,coutinued through May 15. After this date, operation of the trap was interrupted by high flows. Spring chinook counts were significant on the first day of operation. Counts peaked sharply on April 19. Steelhead counts began to increase during and after the spring chinook peak, and shoved a sharp peak on May 14. Due to the early temination of sampling right after this date, it is not knovn If

FIGURE 7

47


1984 Migration timing: Lewiston Trap
Chinook 1's and Steelhead
Daily percent of total sample
April 19
May 14
03/23
04/02
04/12
04/22
05/02
05/12
Chinook 1's
Steelhead

classed as yearling chinook after this date (Koski, NMFS, personal communication). Since this first peak seems early for subyearling (fall) chinook migrants, it is possible that it represents small yearling migrants.

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1984 Migration Timing: Lower Granite

Chinook 1's

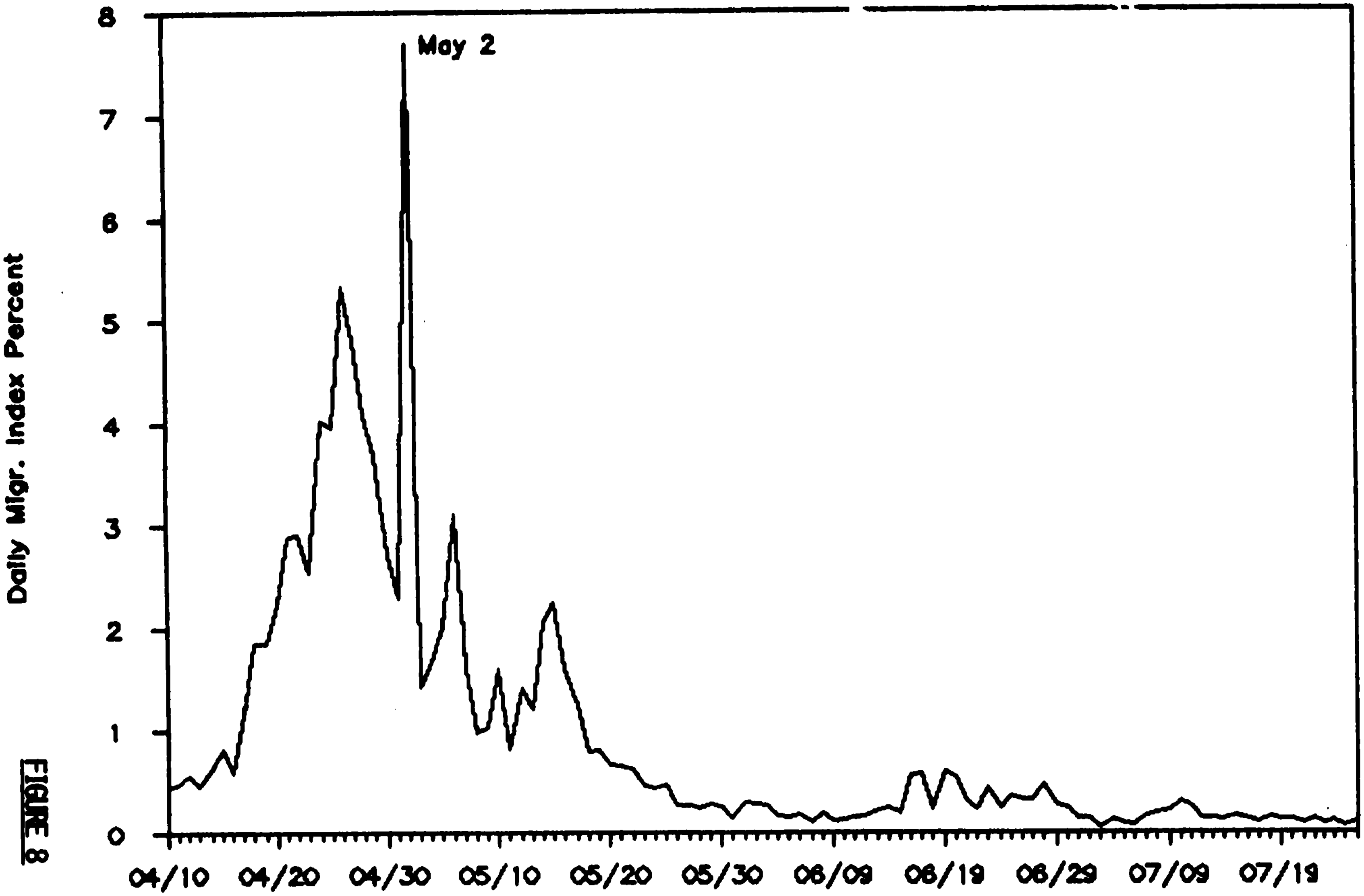

FIGURE 8

1984 Migration Timing: Lower Granite

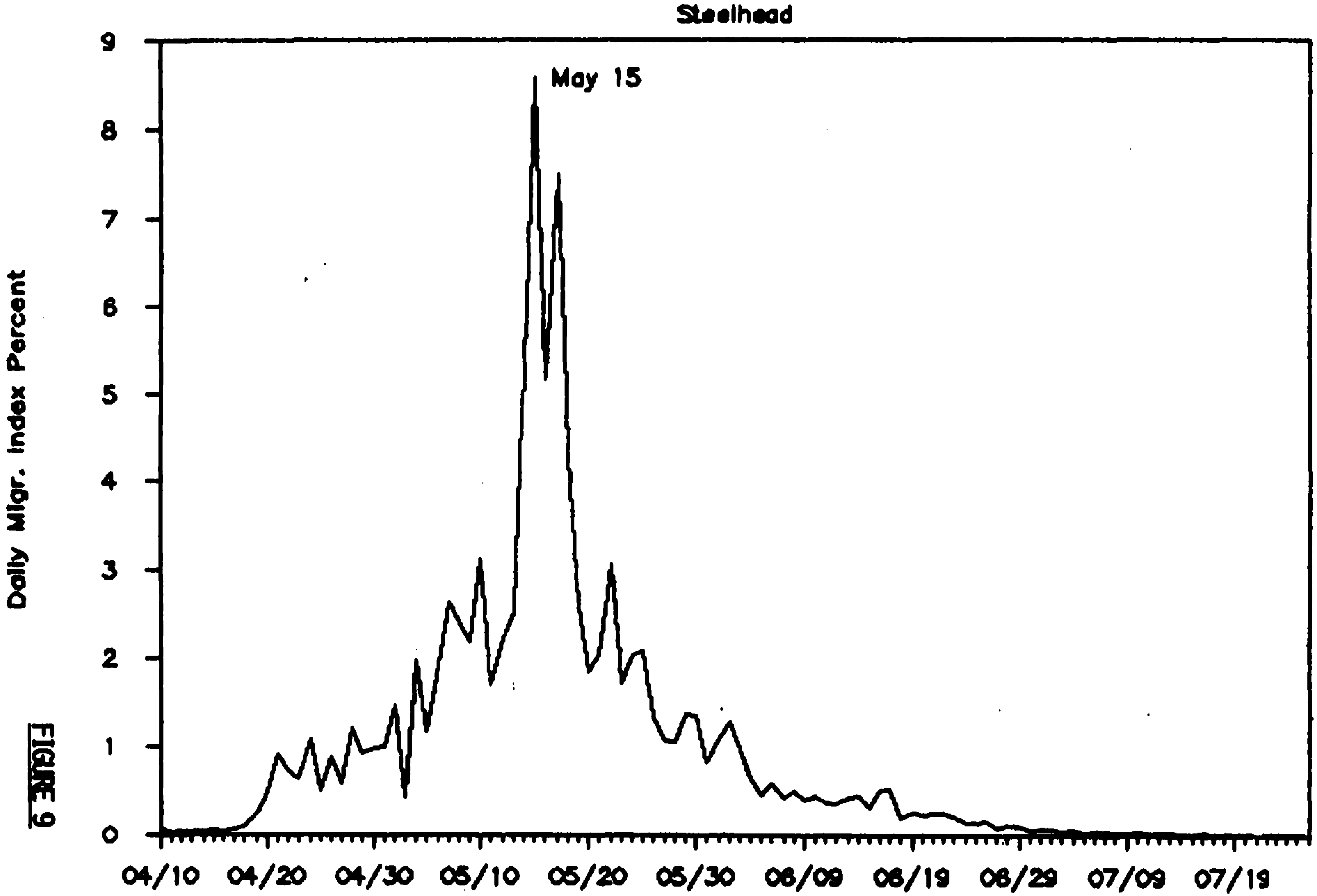

FIGURE 9

1984 Migration Timing: Lower Granite

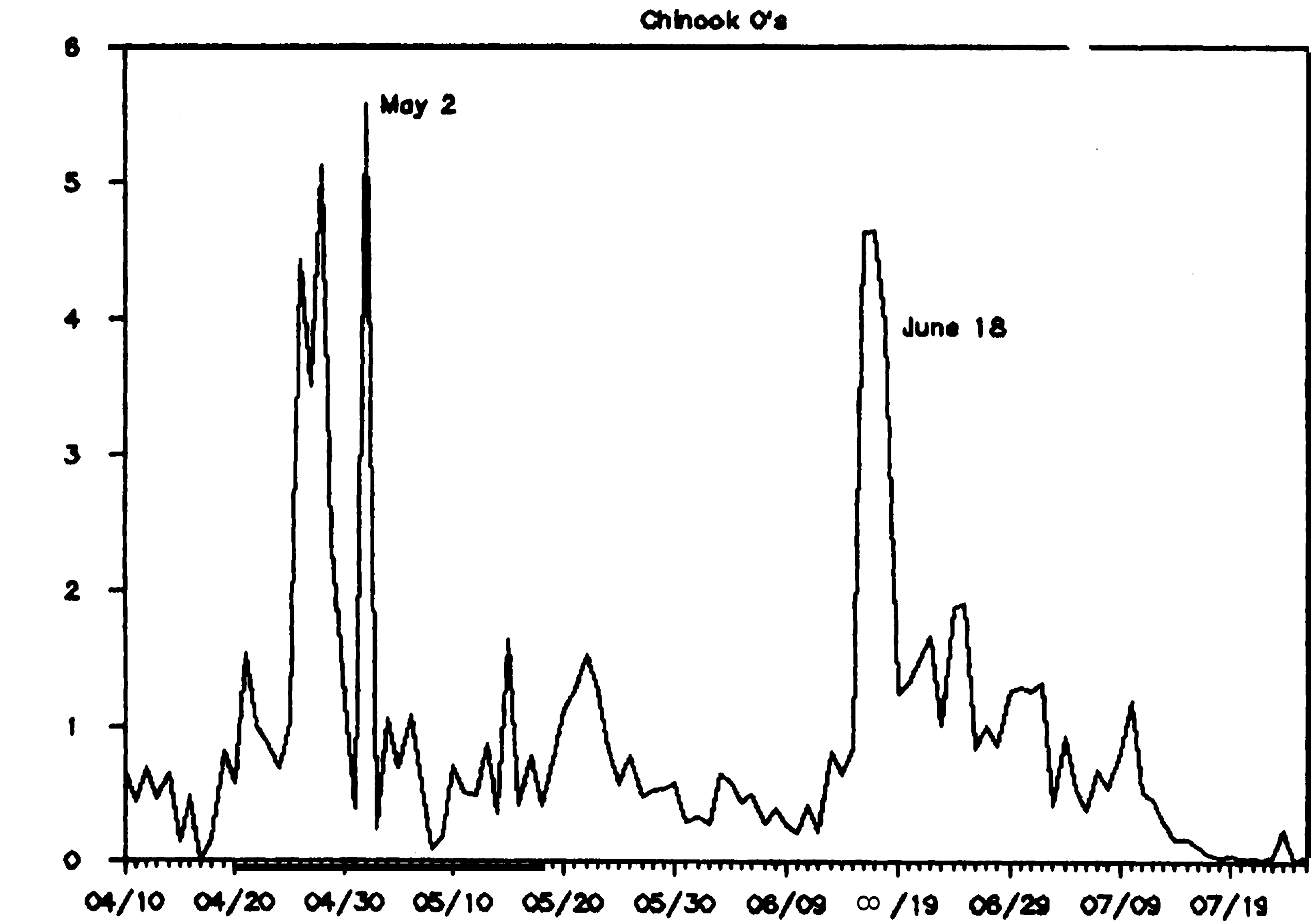

FIGURE 10

Duration of the migration at Lover Granite (measured as the number of days betveen the 10% and 90% dates of recorded passage) was 51 days for yearling chinook, 33 days for steelhead, and 66 days for subyearling chinook.

3. Wells

In the mid-Columbia, the only station which maintained a consistent sampling program with data suitable for characterization of the outmigration was Wells Dam where a hydroacoustic index of fish passage was reported during the spring period. (Gatevell data from Priest Rapids may prove suitable but will require further analysis.) No species composition is available on this data. Passage at Wells shoved two peaks, the first on May 2 and the second on May 29 (Figure 11). Releases of spring chinook from Winthrop National Fish hatchery and steelhead from Wells Hatchery above Wells Dam were delayed in 1984 until April 23. Therefore the first peak probably represents passage of some of these hatchery releases.

4. McNary

At McNary data collection began on April 23 and continued through September 28. Dates of 10% 50% and 90% of the passage within these dates are shown in Table 7. For spring (yearling) chinook, passage peaked on May 21, with median passage occurring on May 11 (Figure 12). Steelhead migration peaked on May 22 while the median date of passage

1984 Wells Dam

Daily Hydroacoustic Index

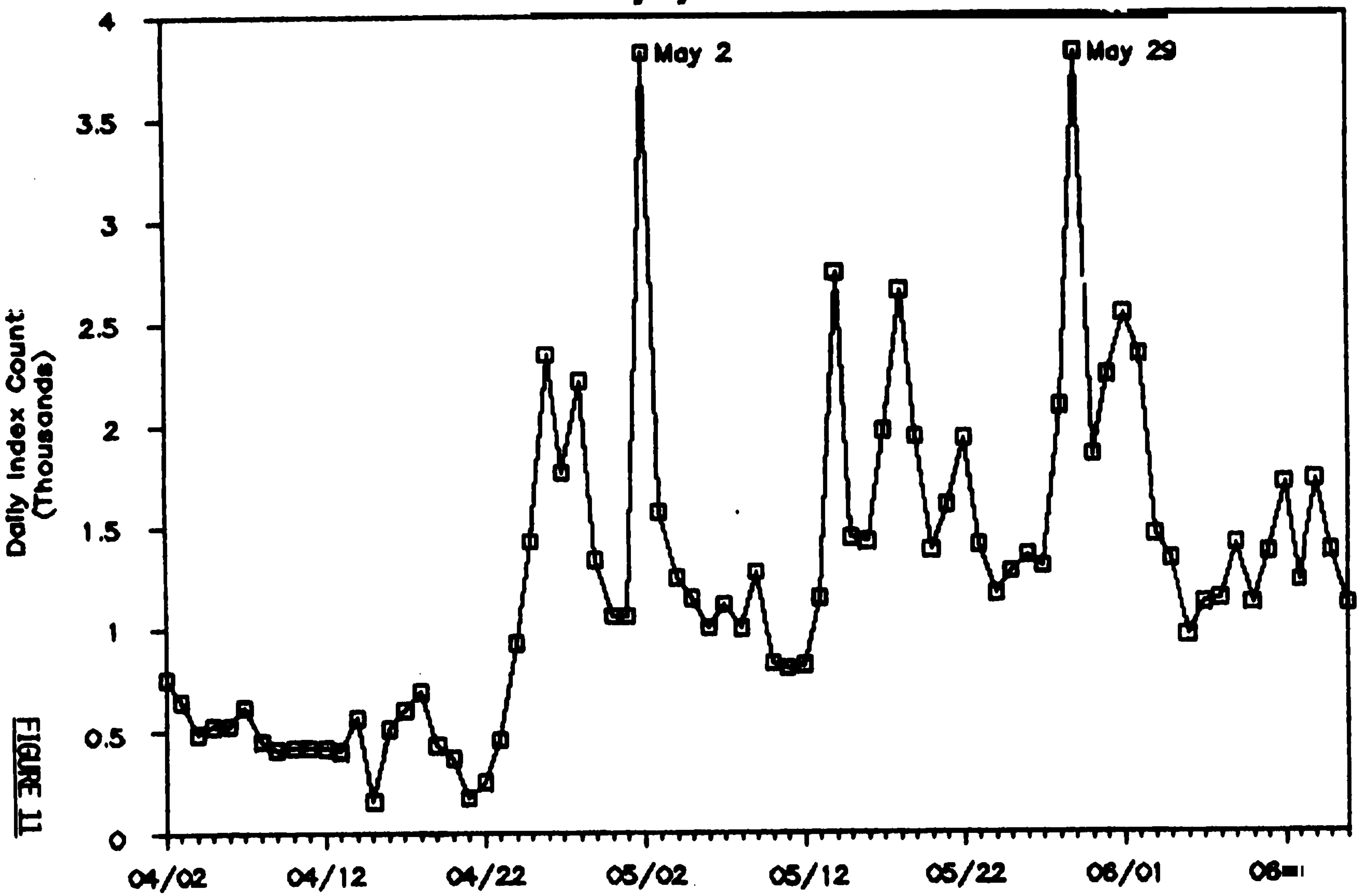

FIGURE 11

1984 Migration Timing: McNary

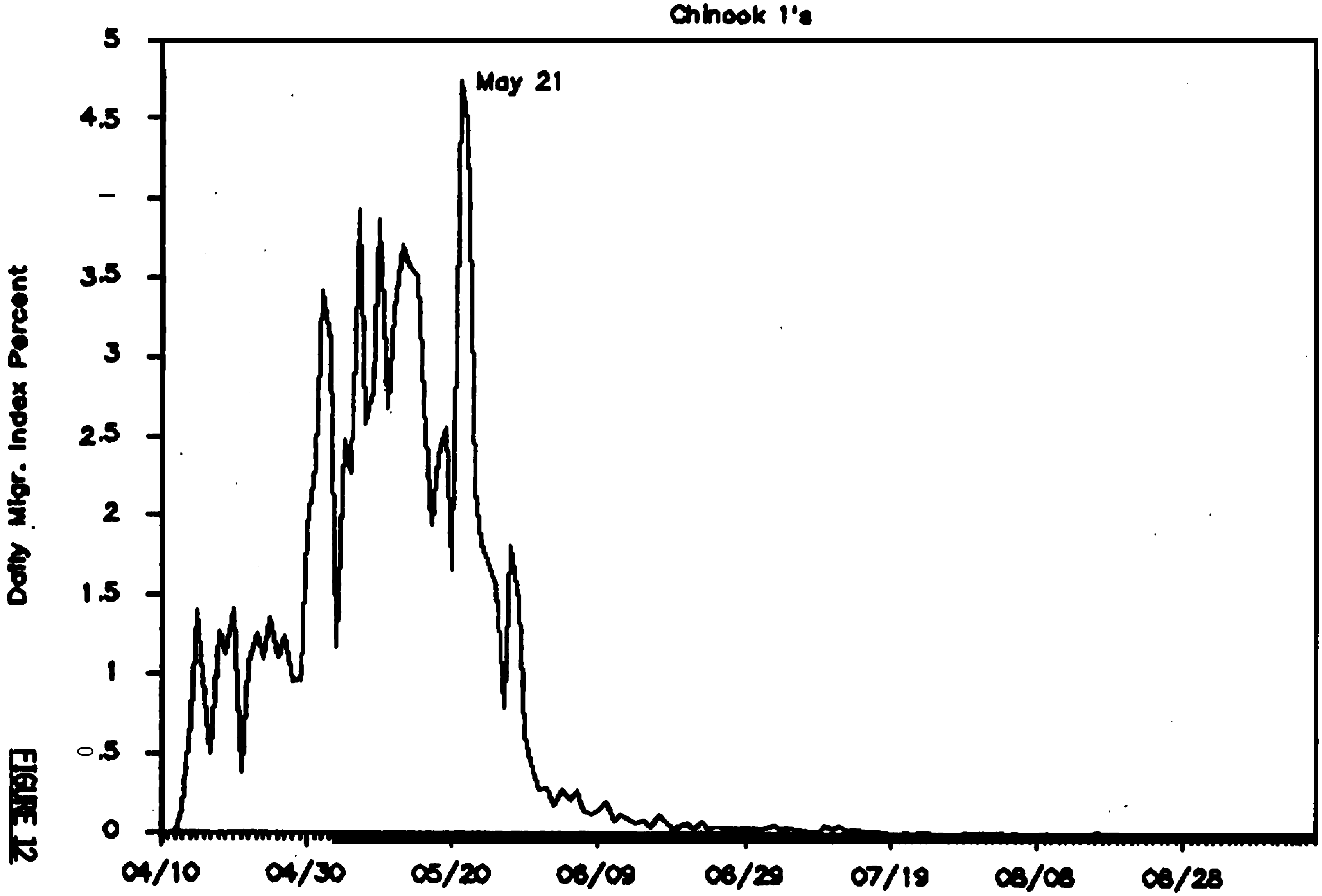

FIGURE 12

occurred on May 19 (Figure 13). Fall chinook (subyearling) migration at McNary took place in about four pulses which peaked on may 26, June 24, July 17, and August 3 (Figure 14). The third peak was the highest, and median passage occurred on July 11.

Duration of the migration at McNary was 32 days for yearling chinook, 39 days for steelhead and 67 days for subyearling chinook.

Table 7. Arrival dates for the recorded chinook and steelhead migration at McNary Dam 1984.

	10%	50%	90%	Duration
chinook l's	April 23	nay 11	nay 25	32 days
Steelhead	April 27	nay 19	June 5	39 days
Chinook O's	June 5	July 11	August 6	67 days

1984 Migration Timing: McNary

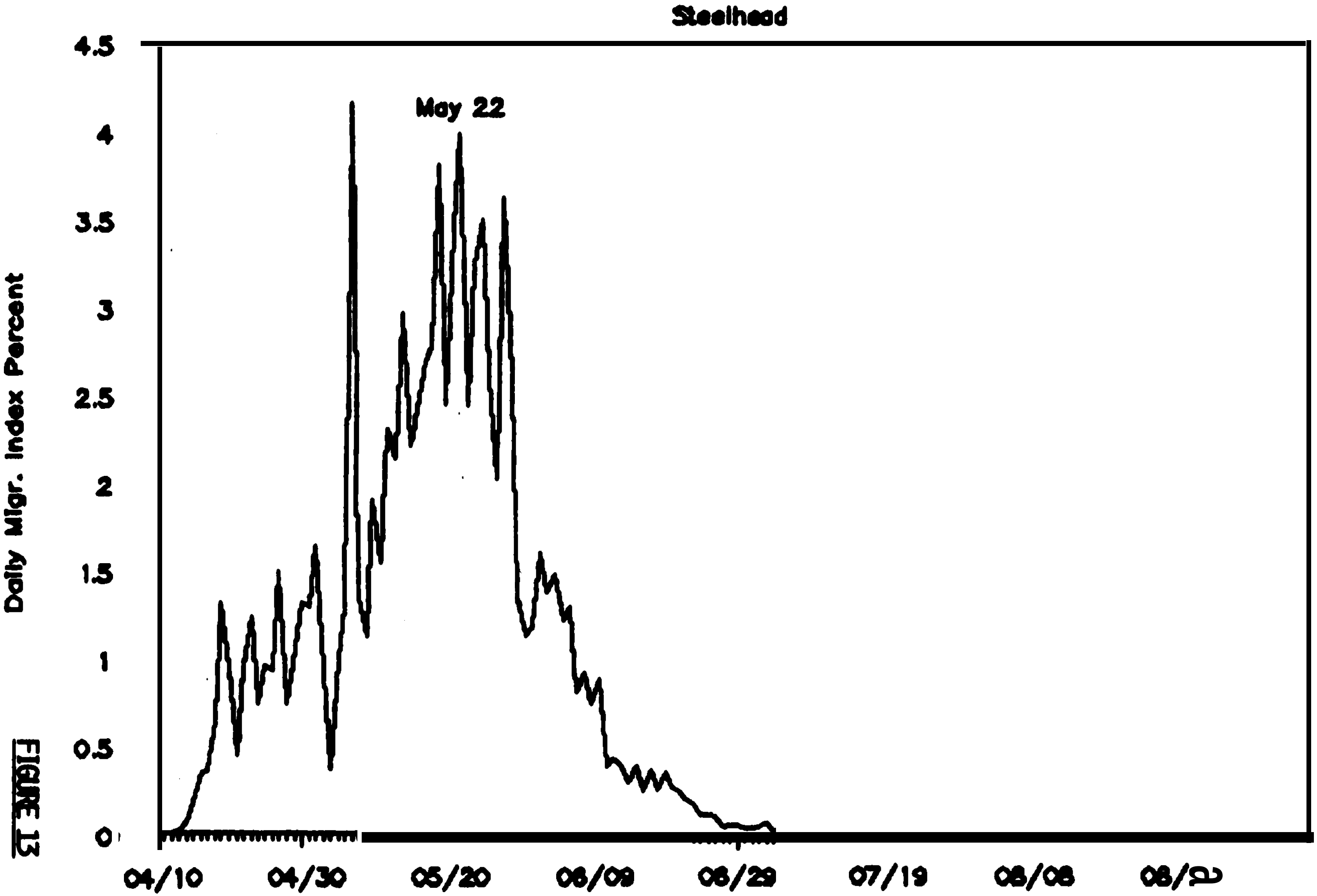

FIGURE 13

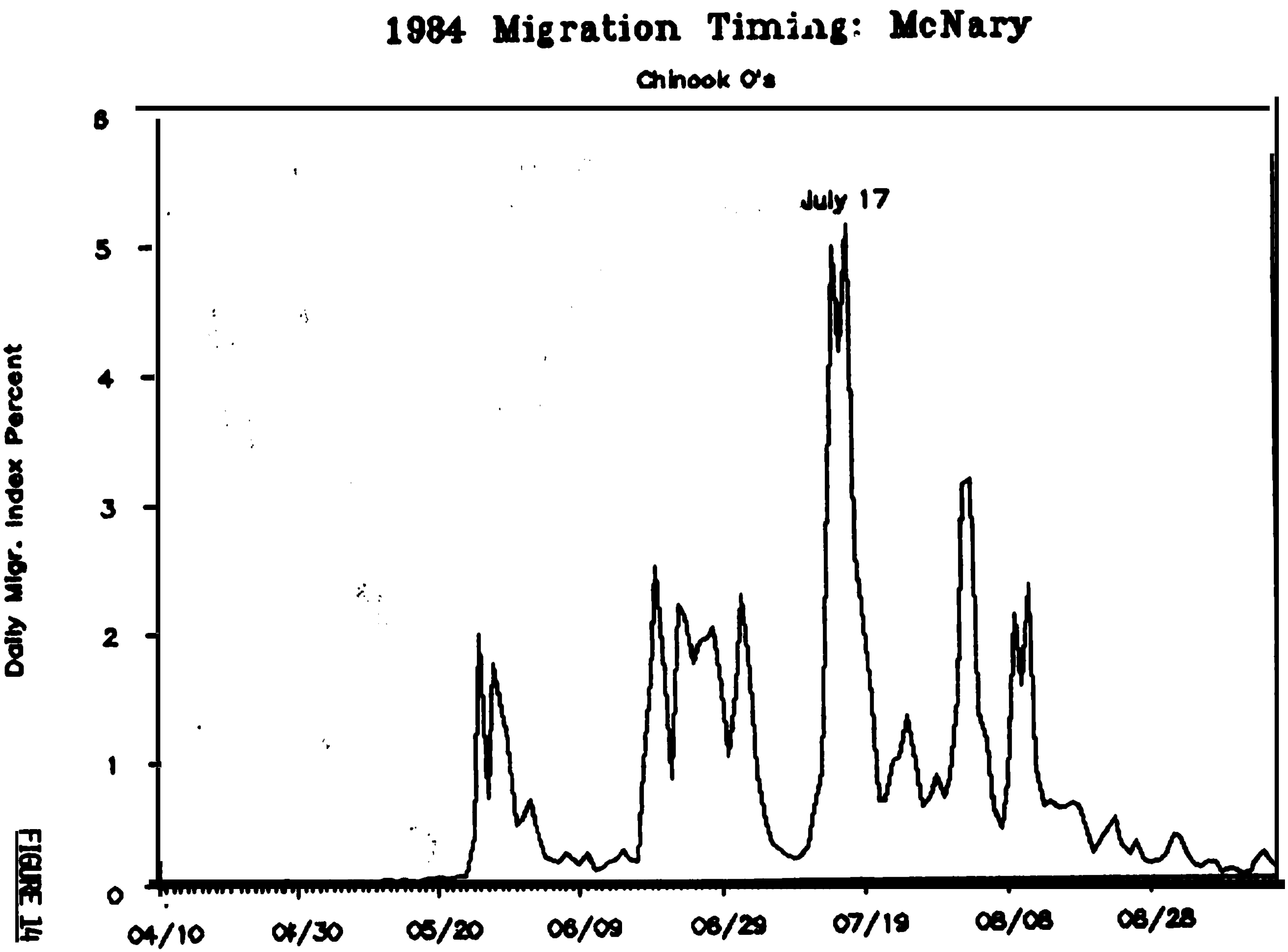
1984 Migration Timing: McNary
Chinook 0's
July 17
Daily Migr. Index Percent
6
5
4
3
2
1
0
04/10
04/30
05/20
06/09
06/29
07/19
08/08
08/28

FIGURE 14

VIII. CONCLUSION

1984 vas the first year of full operation of the Water Budget. During this year, several problems arose, many of which have been discussed in the body of this report, and which bear on the ultimate success of Water Budget to enhance the success of migration through the Columbia System by salmon and steelhead.

The Water Budget is the cornerstone of the Fish and Wildlife Program designed by the Northvest Pover Planning Council. As such, it stands as fundamental to the success of the Council's charge to "protect, mitigate, and enhance" the fishery resource of the Columbia River System. Efforts and money spent to improve and protect habitat, manage harvests, and provide for increased artificial production will have limited ultimate success without a dramatic improverent in migrational survival.. This can only happen when fishery needs are truly co-equal to other system needs as intended in the original legislation forming the Council (Northvest Pover Planning and Conservation Act of 1980).

To accomplish this goal will require a fundamental shift in the priorities and procedures used for planning and operating the Columbia Basin hydroelectric system. The experience of 1984 has dmnstrated that such a shift has yet to occur. Fishery needs were often weighed against secondary pover marketing considerations or other "multiple uses" in contradiction to the priorities stated in the Program, and the spirit of the Act.

It is the opinion of the Water Budget Managers that this attitude lies at the heart of the problems encountered so far in implementing the Water Budget concept. This resistance to change, to adapt to the new realties brought on by the Congressional mandate of the Act, must be countered at all levels if significant improvement in the status of the fishery resource is to be realized.

In 1985, the fishery agencies and tribes will continue to diligently work toward the goals described in the Act and in the Council's program. It is hoped that these efforts will be successful in accomplishing a new _modus operandi_ for system operations as they relate to fishery needs. This will require a re-ordering of priorities within the hydroelectric system, but can be accomplished while maintaining an "adequate, efficient, economical, and reliable power supply".

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