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Instream Flow Requirements LOWER AMERICAN RIVER Sacramento County

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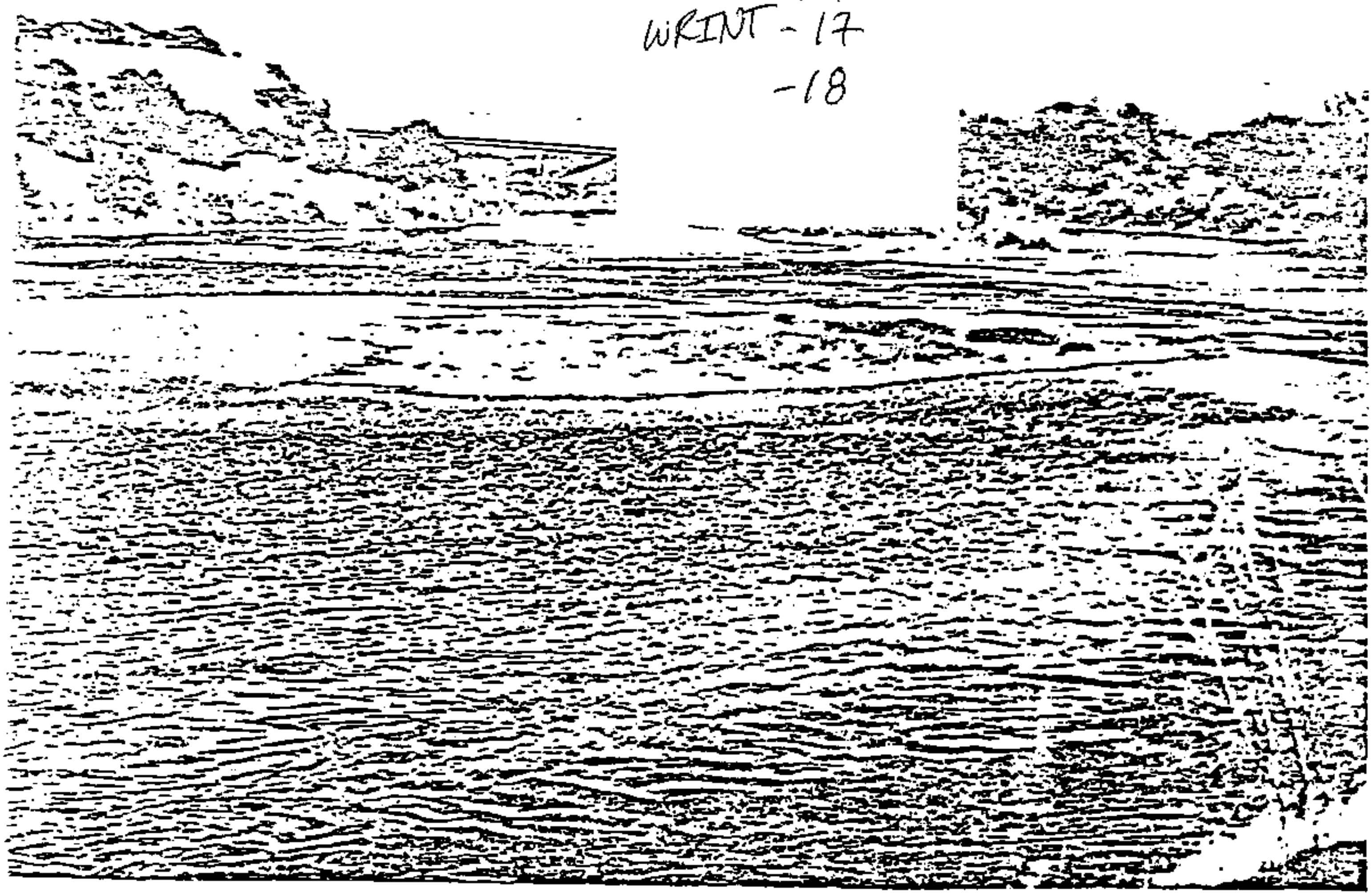

Lower American River fishery resources support over 200,000 angler days each year. Photos courtesy of USFWS.

Department of Fish and Game
Stream Evaluation Report
Report No. 86-1

Instream Flow Requirements of the Fish and Wildlife Resources of the LOWER AMERICAN RIVER, Sacramento County, California

March 1986

Gordon K. Van Vleck Secretary for Resources	George Deukmejian Governor	Jack C. Parnell Director
The Resources Agency	State of California	Department of Fish and Game

The Lower American River- a unique corridor of fish and wildlife habitat within a major metropolitan area. (Sacramento County photo by D. C. McKee)

Instream Flow Requirements of the Fish and Wildlife Resources of the

LOWER AMERICAN RIVER, Sacramento County, California 1/

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ABSTRACT

Data collected during the past 35 years were evaluated relative to the instream flow requirements of the fish and wildlife resources of the lower American River, Sacramento County, California. The evaluation was in response to proposed increases in diversion from Folsom and Nimbus dams. The diversions are the subject of a lawsuit which has been referred to the State Water Resources Control Board. The report was prepared to assist the Board with the referral. The lower American River is in the national and state wild and scenic river systems and sustains recreationally and economically important aquatic resources. The State's fourth largest chinook salmon resource is dependent upon flow from the two dams. These flows also sustain steelhead, American shad, striped bass and a variety of resident game and nongame fishes.

A range of flows encompassing optimum habitat conditions was identified. Available data do not allow exact definition of instream flow requirements. Further evaluation of the instream flow needs of the aquatic resources, specifically the chinook salmon resource, is recommended to enable development of a flow regime to optimize flow dependent habitat in the lower American River.

1/ Stream Evaluation Report No. 86-1, March 1986. Stream Evaluation Program

2/ Environmental Services Division, Sacramento, California

3/ Inland Fisheries Division, Rancho Cordova, California

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SUMMARY AND RECOMMENDATIONS

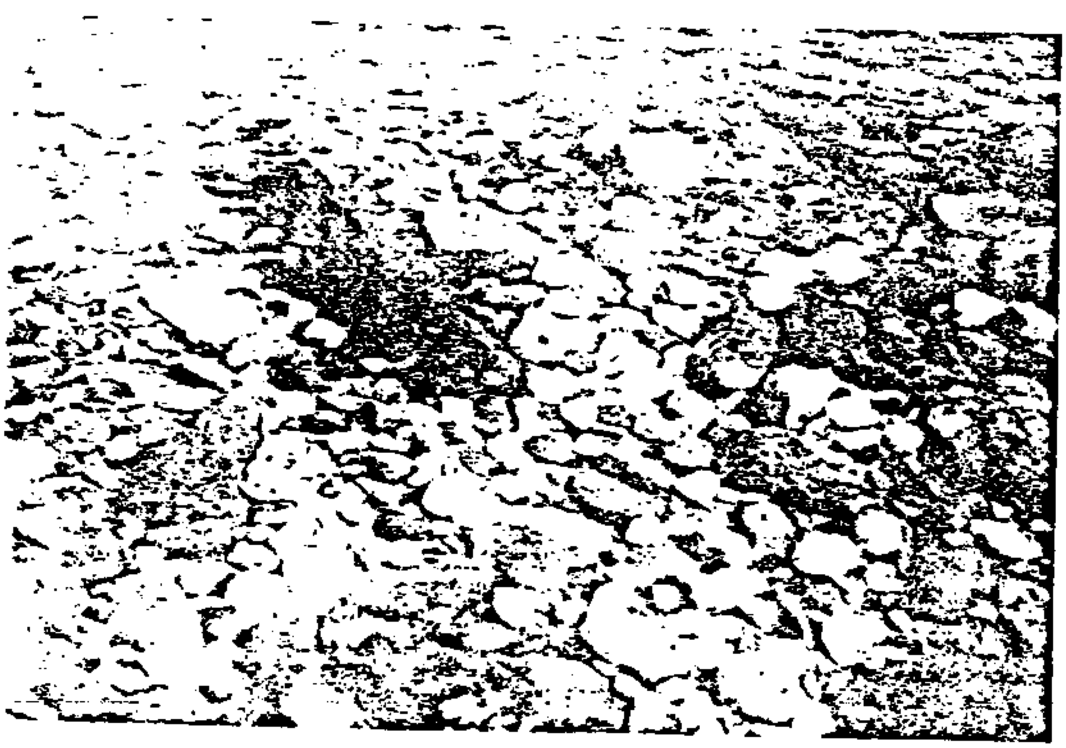
The lower American River, downstream of Nimbus Dam, sustains a diversity of recreationally and economically important fish and riparian resources, including chinook salmon (Oncorhynchus tshawytscha), steelhead (Salmo gairdneri), American shad (Alosa sapidissima), striped bass (Morone saxatalis) and a variety of game and nongame fishes. The importance of the river and its aquatic resources to the people of the state and of the nation has been recognized by its inclusion in both the state and national wild and scenic river systems. Wild and scenic river status and state policies and goals require the maintenance of these resources, including the natural production of salmon and steelhead. Water development, primarily Folsom and Nimbus dams (Folsom Project), has substantially altered these resources. Proposed increases in water development could reduce or even eliminate their natural production if suitable flow dependent habitat is not maintained.

Chinook salmon is considered the most important fish resource in the lower American River. Its flow requirements have been evaluated in various studies throughout the past 35 years. Specific flow requirements, however, have not been agreed upon. Therefore, rather than identify a specific flow regime to optimize each of the salmon's lifestages in the lower American River, we developed a range of flows for each lifestage which encompasses optimum flow conditions. We defined optimum conditions as those that mimic historic, post-Folsom Project conditions which have sustained the fall run chinook salmon resource during the past 31 years. The range limits were based upon study results and average post-Folsom Project flow conditions. Flow requirements for American shad, steelhead and striped bass were identified in a similar manner. Their requirements were then integrated with chinook salmon requirements. The following flow ranges were thus, identified as providing optimum conditions for the fish resources of the lower American River.

Period	Flow range (cfs)	Habitat condition accomodated
Oct 15 to Mar 1	1,750 to 4,000	Salmon and steelhead spawning/ incubation
Mar 1 to Jul 1	3,000 to 6,000	Salmon and steelhead rearing; shad migration
Jul 1 to Oct 15	1,500	Steelhead and trout rearing

We have recommended that further evaluation of specific flow requirements be conducted during the next 3 to 5 years. The objective of the evaluation is to develop a more definitive flow regime recommendation for the fish resources of the lower American River. Until the flow ranges are refined, the Department of Fish and Game (DFG) considers the maximum flow in each range to optimize flow dependent habitat.

The fate of the American River's anadromous fish resources is also dependent upon conditions in the Sacramento River and its estuary. Smolt survival, escapement and ultimately natural production of the American River chinook salmon resource are certainly affected by downstream conditions. The goal of maintaining a naturally sustained salmon resource in the lower American River will not be sacrificed, however, to accomodate declining downstream conditions. Rather, state policies and goals require that the downstream problems be addressed and resolved to make downstream conditions amenable to natural salmon production.



Spawning chinook salmon. (Sacramento County photo by D. C. McKee)

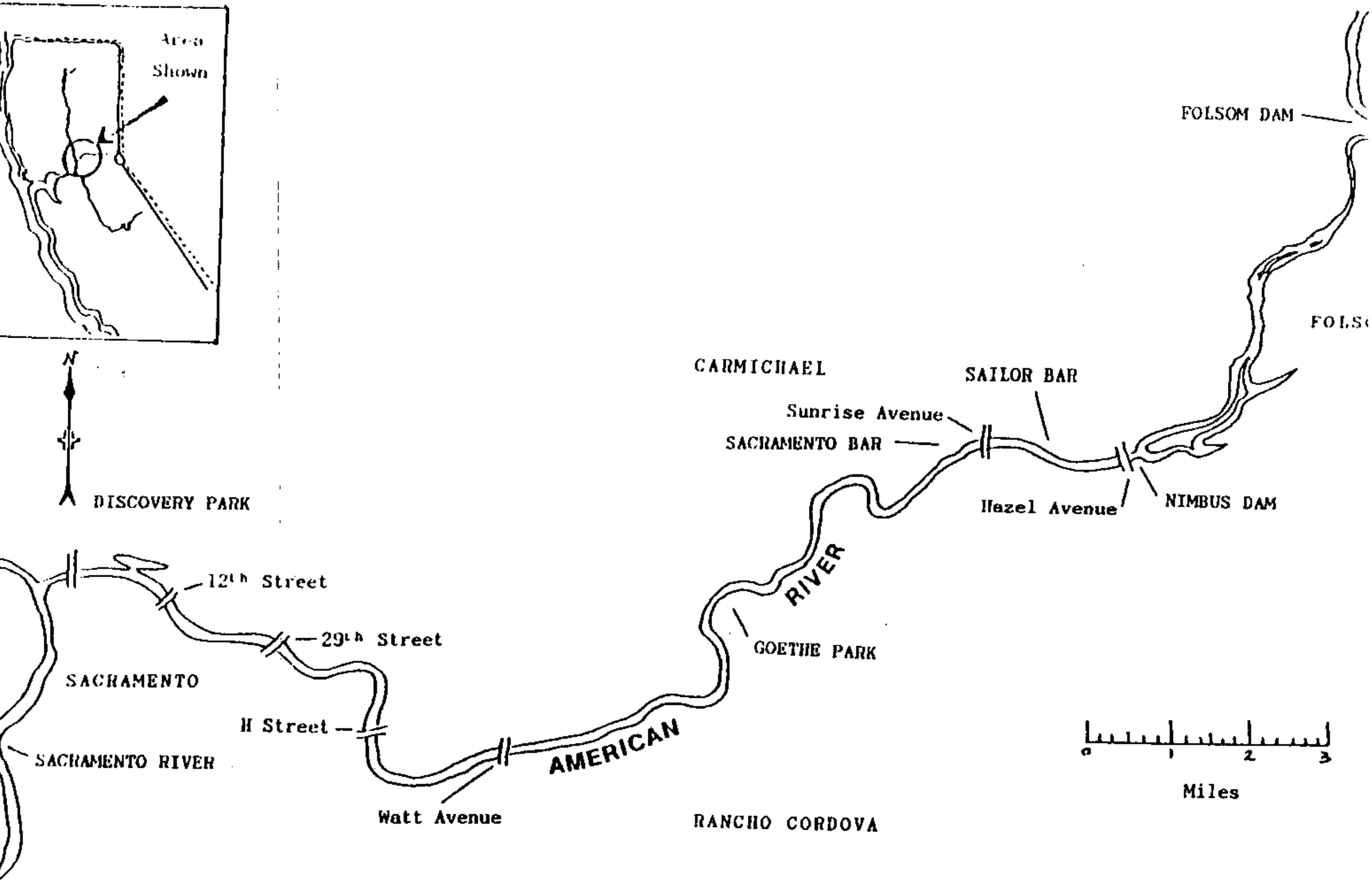
INTRODUCTION

The lower American River, below Nimbus Dam (Figure 1), sustains a diversity of recreationally and economically important aquatic and riparian resources, including the fourth largest chinook salmon resource in the State (Gerstung 1971). The future of these resources, however, is uncertain. Existing water development has already substantially reduced the fish resources of the American River system. Increases in water diversion adjunct to existing and proposed water development projects, could further alter these resources, potentially reducing or even eliminating natural production. The flow-dependent habitat requirements must be clearly identified, thence maintained through promulgation of a comprehensive flow maintenance agreement to assure continued viability of the lower American River fish resources.

The significance of the lower American River fish resources is clearly demonstrated by its economic and recreation contribution to the people of California. One out of every six salmon caught in the ocean commercial and sport fisheries is produced in the American River (USFWS 1984). This annually accounts for over 1 million pounds of harvested salmon. In addition, between 150,000 and 200,000 angler days are annually spent on the river; the estimated annual yield averages 15,000 chinook salmon, 5,000 steelhead, 20,000 American shad and 1,000 striped bass (Hooper 1970, Gerstung 1971, Staley 1976, Meinz 1981 and DFG file rpts). The market and non-market values of the commercial and sport fisheries average $15 million and $24 million, respectively (Meyer 1985).

The importance of the lower American River to the people of the State has been further demonstrated by federal, state and county governments. In recognition of its outstanding fishery and recreational attributes, the California Legislature included the lower American River in the State Wild And Scenic River System in 1972. Similarly, it was included in the National Wild and Sceneic River System in 1980. The County of Sacramento and the State have also expended considerable time and expense to provide continued access and recreational use of the river and adjacent land, by establishing the American River Parkway. The Parkway is considered a very valuable asset to the County. It supports over 5 million visitor days annually, with an estimated non-market value of $96 million. In comparison, neither Yosemite nor Yellowstone National Parks supports 5 million visitor days a year.

The existing, highly valued fish and riparian resources of the lower American River are currently maintained by regulated flow releases from the Folsom-Nimbus dam complex, operated by the Bureau of Reclamation. Flows released from the complex are presently regulated by State Water Resources Control Board (SWRCB) Decision 893. D893 requires a minimum 500 cfs flow between September 15 and January 1, and a minimum 250 cfs release the remainder of the year for the maintenance of aquatic resources. However, the actual releases have approached these levels only once, during the 1976-77 drought. Relatively high releases have been maintained because the projected demands for project water have not yet been realized. This status, however, is likely to change within the near future: East Bay



URE 1. Lower American River, Sacramento County, California.

Municipal Utilities District (EBMUD) has contracted to take delivery of 150,000 acre-feet via the Folsom-South Canal; South Placer County Water Agency and San Juan Urban Water District also propose to contract with the Bureau; the California Department of Water Resources and the federal government have recently negotiated a cooperative operation of State Water Project and Central Valley Project facilities which would place additional demand upon American River water; and the proposed Auburn Project, if approved and built, would increase the capacity to divert water at the Folsom-Nimbus complex.

If Auburn Dam were built, flow releases to the lower American River would be regulated by SWRCB Decision 1400. D1400 requires fish maintenance flow releases of 1,250 cfs between October 15 and July 15, and 800 cfs during the remainder of the year. This requirement is generally superceded (i.e., except during dry years) by a 1,500 cfs recreation flow requirement, between July 16 and October 14. However, the adequacy of D1400 flows, let alone D893 flows to accommodate the policies and goals of the State is questionable (Rich and Leidy 1985, Kelley, Bratovich, Dettman and Rooks 1985).

The Alameda County Superior Court has referred the case of EBMUD vs. the Environmental Defense Fund et al. to the SWRCB for review and recommendation. Of concern, is the impact of the proposed diversion via the Bureau's Folsom South Canal to EBMUD facilities, and the associated impacts upon the river's instream beneficial uses. A key issue is the protection of the flow dependent fish and wildlife resources of the lower American River and the Sacramento River system downstream from their confluence.

It is incumbent upon the State of California, specifically DFG, to evaluate the potential impacts of future water development upon the river's fishery and riparian resources relative to DFG management policies and objectives, Fish and Game Commission policies, the Fish and Game Code and the mandate of the State Wild and Scenic Rivers Act. Collectively, state policy and law require DFG to provide for the preservation of optimum or enhanced natural production of salmon and steelhead resources and the maintenance of all other fishery values associated with the lower American River. The purpose of this report is to summarize available information concerning the required flow dependent habitat conditions of the fish resources of the lower American River, and to identify, where possible, flows required to uphold the public trust placed upon DFG and meet the laws and policies of the state.

KEY ISSUES

The key issues to be addressed in this report are:

1. What flows are required to sustain optimum levels of natural fish production in the lower American River?

2. Are the flows prescribed by D893 and/or D1400 adequate to sustain optimum levels of natural fish production and protect riparian wildlife habitat?

3. What additional information is needed to clearly identify an optimum flow regime?

4. How best should the information concerning an optimum flow regime be used to preserve optimum levels of natural fish production and riparian wildlife habitats?

BACKGROUND

Pre-Folsom Project

The history of the American River fish resources has been summarized by Gerstung (1971). In general, the river once sustained large populations of spring and fall run chinook salmon and spring, summer and winter run steelhead. The estimated escapement of chinook salmon was over 129,000 fish (Sumner and Smith 1942). The majority of these fish were produced above the Nimbus Dam site. Damage from mining (millions of tons of mining spoil buried most of the river in the 1860's) and the construction of numerous dams throughout the drainage, eventually led to the near extirpation of salmon and steelhead by 1900. Spring run salmon and spring and summer run steelhead were virtually non-existent. By the time Folsom Dam was built, in 1955, most salmon and steelhead producton occurred in the lower 30 miles of river. Salmon and steelhead production, including summer and spring runs were showing signs of coming back in the upper river, after access was provided over the lowermost dam, near Folsom, and mining damage had abated (in the 1940's). Unfortunately, any chance for the restoration of these resources was lost when the Folsom Project permanently blocked access to the historic spawning and nursery areas.

Post-Folsom Project

In 1952, just prior to the construction of the Folsom Project, the U.S. Fish and Wildlife Service (USFWS) and DFG evaluated salmon spawning flow requirements needed to maintain natural salmon production below Nimbus Dam. The results of this study were the basis for D893 flow requirements. In 1966, DFG decided to reevaluate salmon flow requirements relative to the proposed Auburn Dam-Folsom South Canal Project. Using more refined techniques and improved criteria, salmon spawning habitat flow requirements were revaluated. Incubation and rearing habitat needs, however, were not evaluated. The objective of the 1966 study was to identify the flow required to mitigate loss of the "average" salmon escapement above Nimbus Dam. The results of this study were the basis for D1400 flow requirements.

The 1966 study results indicated that the D893 flow regime would not sustain optimum natural production levels under the post-Folsom Project channel conditions. The ability of D1400 flows to sustain optimum habitat conditions has not been tested. However, results of a third study, conducted by USFWS in 1981, indicate that optimum spawning habitat would be provided at 1,750 cfs, suggesting that D1400 spawning flows (i.e., 1,250 cfs) would not sustain optimum habitat conditions (USFWS 1985). Unfortunately, the 1981 study was unable to clearly define rearing habitat needs due to a variety of problems (Rich and Leidy 1985, Kelley et al. 1985), leaving us still without a clear understanding of the flow conditions required to optimize natural production of salmon, let alone the other important fish resources using the lower American River.

CONSIDERATON OF SALMON RESOURCE HABITAT REQUIREMENTS

The primary goal of salmon management in the State is to optimize the natural production of salmon in order to maximize commercial and sport fishery harvest while maintaining optimum escapement. Previous salmon habitat evaluations in the American River dealt primarily with determining spawning habitat requirements necessary to accommodate spawning escapement goals. The basic assumption of these evaluations was that spawning habitat flow requirements would be greater than flows required by all other lifestages, and as such, would optimize instream chinook salmon production. Intuitively, there are problems with this approach. Since salmon evolved with seasonal variations in flow, it is logical that flows that mimic natural variations, rather than a constant flow based solely upon spawning requirements, are more likely to provide optimum conditions for the various lifestages. Typically, initiation of spawning activity is associated with increasing flow and decreasing water temperatures; incubation, emergence and fry rearing are associated with the higher, cooler flows extending through winter; and juvenile rearing and smolt emigration are associated with the even higher spring flows. Another problem with using spawning flow data to establish season long flow requirements is that smolt production, not necessarily spawning habitat, generally limits the production of adults. Results of increasing spawning habitat in the Yuba River drainage without a corresponding increase in rearing habitat has failed to increase adult production. Studies on the upper Sacramento River showed that smolt survival increased with improvement in rearing habitat conditions (Kjelson, Raquel and Fisher 1981). Even in hatcheries, where the number of escaped fish could limit hatchery production, management is concerned with smolt production and survival as a predecessor to achieving management goals. Numerous investigations have shown that by optimizing hatchery smolt production and survival, the potential for realizing mangement goals is increased.

Management of the American River salmon resource should be concerned with optimizing smolt production and survival by optimizing rearing habitat conditions, by providing sufficient spawning and incubation to accommodate optimum rearing habitat conditions and by optimizing conditions required for successful emigration to the ocean. Thus, using the results of previous studies to develop an optimum flow regime is inappropriate. The question then is, what can be done to provide optimum conditions for the production and survival of smolts?

Optimum smolt production is the result of a diversity of factors. In general, these factors are a function of macrohabitat conditions, such as water quality and temperature, and microhabitat conditions, i.e., the physical conditions which form the actual space used by the fish. By optimizing macro and microhabitat conditions for each lifestage contributing to smolt production and survival, adult salmon production goals can be achieved.

Spawning Flow Requirements

In order to attain optimum smolt production, adequate spawning habitat must be provided to produce sufficient numbers of fry to occupy all rearing habitat that would be available under optimum conditions. The amount of spawning habitat required to achieve this objective is unknown. Kelley et al. (1985) illustrated a procedure to estimate the amount of smolt production which can be sustained by a specific amount of spawning habitat. However, this method relies upon numerous, untested assumptions. Since even the slightest deviation in any one of these assumptions could substantially alter the estimated production of salmon, we have decided that the best way to establish spawning flow requirements, is to first identify optimum spawning habitat conditions, and then identify acceptable reductions based upon data relating spawning abundance to smolt production developed specifically for the lower American River.

Microhabitat

The flows required to sustain spawning habitat at optimum levels are still unresolved. Each of the three studies evaluating spawning habitat requirements in the lower American River had distinctly different results. One possible reason for the differences is that channel conditions are changing. Portions of the lower American River apparently are in disequilibrium and possibly the substrate and general morphology of the spawning areas (i.e., riffles) are changing (Hecht 1984). Another reason for the discrepencies may be the different methods used to define and estimate spawning habitat. In 1952, 500 cfs was identified as the optimum spawning flow (Gerstung 1967). However, using improved methods to evaluate spawning flow requirements in 1966, DFG determined that spawning habitat increased as flow increased, up to 4,000 cfs (Gerstung 1971). Furthermore, results indicated that 500 cfs did not provide enough spawning habitat to sustain even half the objective spawning population (26,500 fish). Although the study showed that 4,000 cfs optimized spawning habitat, 1,250 cfs was recommended to accommodate the objective of maintaining the estimated, average, pre-Folsom Project escapement population.

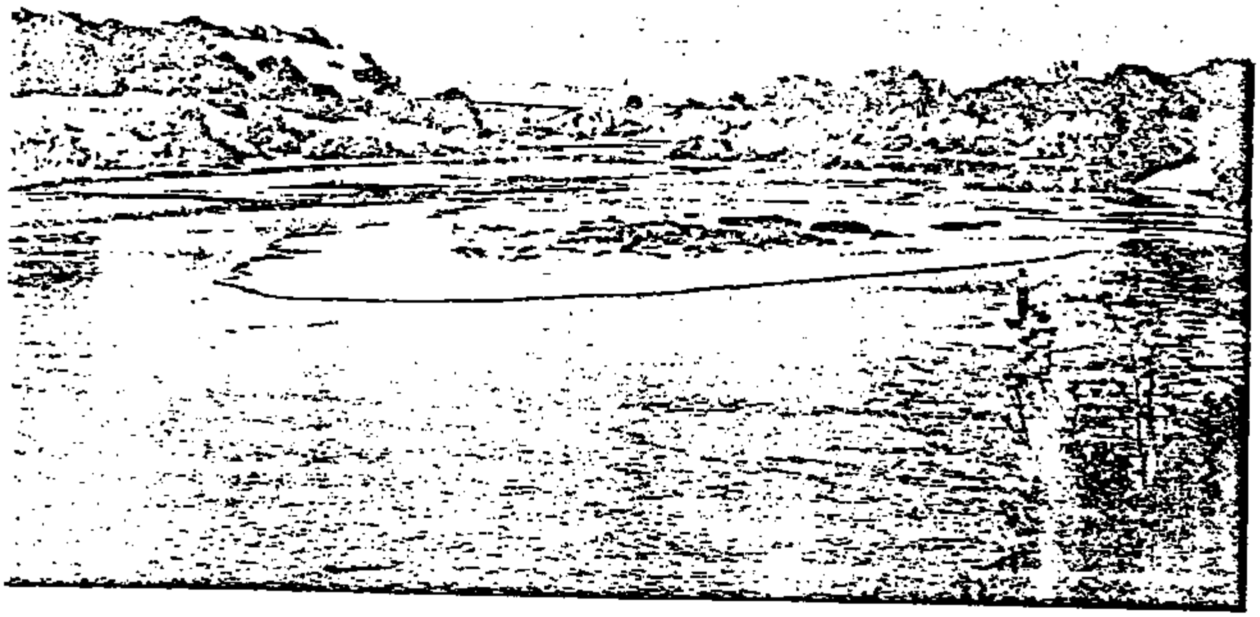
The USFWS has identified 1,750 cfs as the optimum spawning flow based upon an Instream Flow Incremental Methodology (IFIM) study (USFWS 1985). DFG considers the IFIM to be one of the best methods available for evaluating the relationship between flow and fish habitat. It is very flexible and can accommodate a variety of assumptions. At the same time, it can be very sensitive to changes in assumptions and slight errors in data entry, calibration of the hydraulic model used to simulate flow conditions at various flows, etc. In light of the potential problems associated with the IFIM, and due to the large discrepency between the 1966 study results and the USFWS study results, we believe that further evaluation of spawning flow requirements is needed. Kelley et al. (1985) and Rich and Leidy (1985) also noted the discrepencies, concluding that the IFIM study be reevaluated to better define the relationship between flow and spawning habitat. Kelley attributes the discrepencies to differences in the definition of spawning habitat. The 1966 study concentrated on riffle areas, the IFIM study encompassed riffle, pool and run areas. Kelley suggests that the spawning habitat versus flow relationship would be different if the IFIM study were to be applied strictly to riffles. This approach would be applicable if spawning is indeed restricted to riffles, and would not occur in pools or runs regardless of whether spawning conditions, in terms of velocity, depth and substrate, are present.

If Kelley is right, the results of the 1966 study should accurately describe the relationship between flow and spawning habitat, at least between 500 and 1,500 cfs, since it was derived empirically. The amount of spawning habitat available at flows greater than 1,500 cfs, however, was determined by measuring the wetted riffle area using aerial photographs, and extrapolating the relationship observed at the lower flows (i.e., as flow increased and wetted area increased the portion of suitable spawning area also increased). It was assumed, therefore, that optimum spawning habitat availability would occur when the riffle was completely inundated at 4,000 cfs. The IFIM results indicate that as flow increases above 1,750 cfs, spawning conditions deteriorate, even though wetted riffle area increases. This is due to increases in velocities above preferred levels, associated with increases in flow. However, in as much as the velocity considered in the IFIM study is mean column velocity, rather than the velocity immediately above the redd site (0.3 ft), as was used in the 1966 study, it is possible that the IFIM results underestimate the suitability of areas of relatively high mean column velocity, if the mean column velocity is indeed significantly greater than the velocity 0.3 ft off the bottom. Such was the case with the 1952 study (Gerstung 1971).

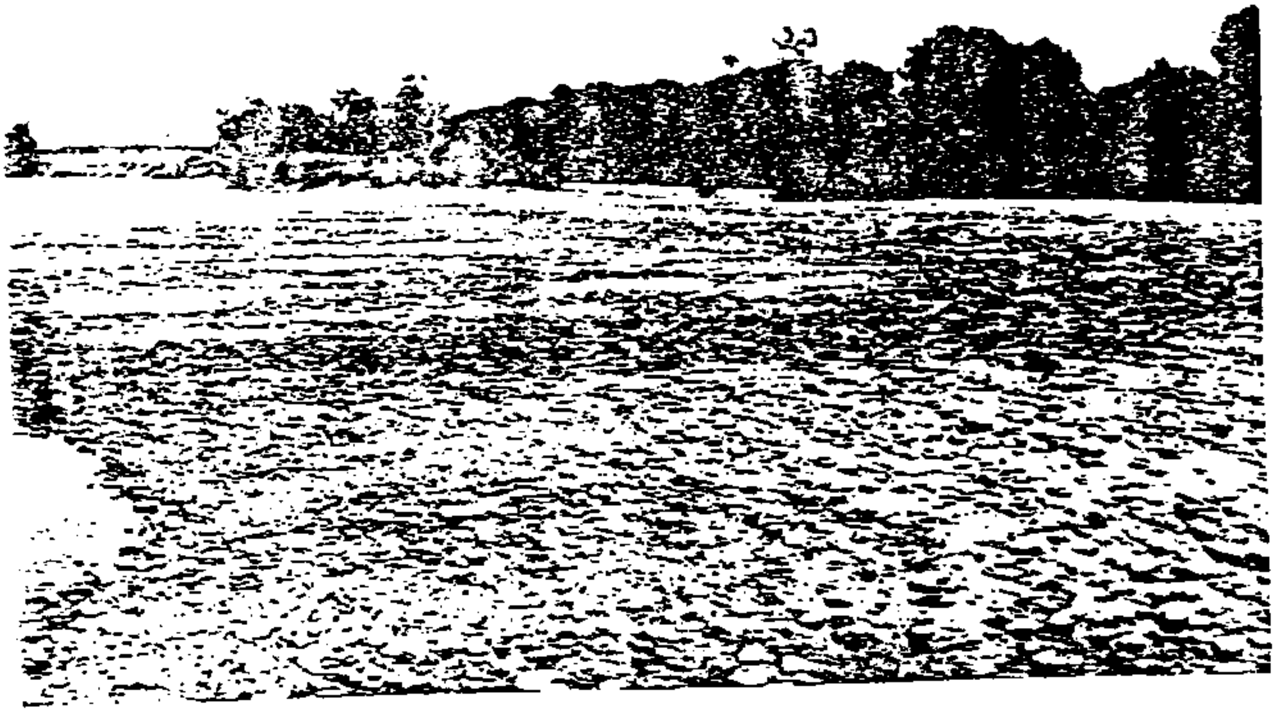
The differences between the study results may have been further exacerbated by apparent changes in the morphology of the stream since construction of the Folsom Project. USFWS identified the Sailor Bar sample site as representative of the river from about Sacramento Bar to Nimbus Dam, the area which reportedly sustains over 75% of salmon spawning (USFWS 1985). However, Hecht (1984) reports that the upper 2 miles of stream, from just below Sailor Bar to Nimbus Dam, is downcutting. Therefore, flow optimizing spawning conditions in this reach, may be substantially lower than the flow optimizing spawning conditions within the remainder of the river. Thus, using the results obtained from the Sailor Bar study site to predict future habitat conditions below Sailor Bar is questionable.

Macrohabitat Conditions

The most important macrohabitat condition relative to spawning in the lower American River is temperature. Salmon spawning temperature requirements are well documented. Spawning temperature criteria are based upon successful egg incubation after spawning. Increases above the optimum level (56 F), reduces egg survival (Leitritz and Lewis 1980). The



The affect of flow upon critical spawning and rearing habitat is graphically depicted at Sailor Bar. Most of the Sailor Bar riffle is poorly suited for chinook salmon at 500 cfs (upper), 1,250 cfs (lower) and 1,500 cfs (opposite, upper). Even at 2,500 cfs, habitat conditions appear suboptimal. (upper, lower and opposite lower photos by USFWS; opposite upper by D. C. McKee, Sacramento County)



magnitude of the decrease in survival is directly related to the period and degree of exceedance (Rich and Leidy 1985).

Post-Folsom Project Spawning Conditions

Since the Folsom Project began operating in 1955, the average October flow has been 1,850 cfs, the average November flow (excluding 1983 when flow averaged over 11,000 cfs and 1973 when flow averaged nearly 7,000 cfs) has been about 2,200 cfs, and the average December flow (excluding 1964, 1970, 1981 and 1983 when flows exceeded 7,000 cfs) has also been about 2,200 cfs,. Amenable temperatures first occurred anywhere from mid-October to early December, generally after November 15.

Gerstung (1971) and Kelley et al. (1985) attempted to identify an empirical relationship between spawning habitat conditions and flow. Assuming the number of spawners entering the hatchery or moving beyond the hatchery to Nimbus Dam had rejected spawning conditions downstream, they compared the proportion of fish using the river, thus the proportion of fish rejecting river conditions, with average November flows. Although there appeared to be some relationship between flow and rejection, the validity of using estimated escapement as a variable is questionable. A critical review of the spawning escapement estimates (since 1952) made independently by DFG personnel and by Alice Rich (unpubl. rpt.), suggest that comparing spawning escapement from year to year is inappropriate. The primary problem with such a comparison, is a definate lack of consistency in estimate methods. Assumptions as to the percentage of fish observed during the escapement surveys appeared to vary with personnel. The area of river surveyed also varied. An example of how changes in methods affected estimates is found in the 1956 survey data. The estimated escapement was obtained by multiplying the number of observed fish by 2 (i.e., assumed that 50% of the fish were observed), however sampling conditions were very poor (muddy water) throughout a majority of the sample area, and the survey was conducted only once a week, between mid-October and December. George Warner (unpubl. rpt.) had previously concluded that even under the best survey conditions, and with daily surveys, only 20% of the fish would be observed. Thus, the 1956 escapement estimate of 6,500 fish is likely very low, however, there is no confident way of correcting it. Since there doesn't appear to be a way to place confidence limits about these estimates, it is difficult to justify relating changes in flow conditions with escapement numbers. Other problems associated with Kelley's and Gerstung's analyses are: the number and timing of fish entering the hatchery is a function of hatchery operation, the method of estimating fish moving above the hatchery was untested and the concentration of angling and fish between the hatchery weir and the dam accounts for a significantly greater proportion of angler harvest than anywhere else in the river, thus drastically affecting the measurement of fish rejecting downstream spawning conditions.

Historically, temperature generally was not a problem since chinook had free access to the upper, cooler portions of the drainage. In fact, most spawning activity probably occurred earlier than is possible today. Most chinook were spring run, which typically spawn earlier than fall run fish (as early as August), and most fall run fish were known to move above the existing Nimbus Dam site where temperature conditions were conceivably suitable earlier. Early salmon runs were observed as recent as 1953. Under present conditions, however, amenable spawning temperatures typically are not present until November, sometimes not until late November after many chinook have already spawned. Depending upon how much and how long temperature exceeds optimum (56F) after spawning, as much as 100% of the early spawn can be lost. In as much as smolt survival is a function of size at emigration, loss of early spawning can critically affect salmon production. Early spawning would be expected to contribute a significant portion of the large smolts present in early spring when emigration conditions appear best which, perhaps, is why pre-Folsom emigration peaked in April.

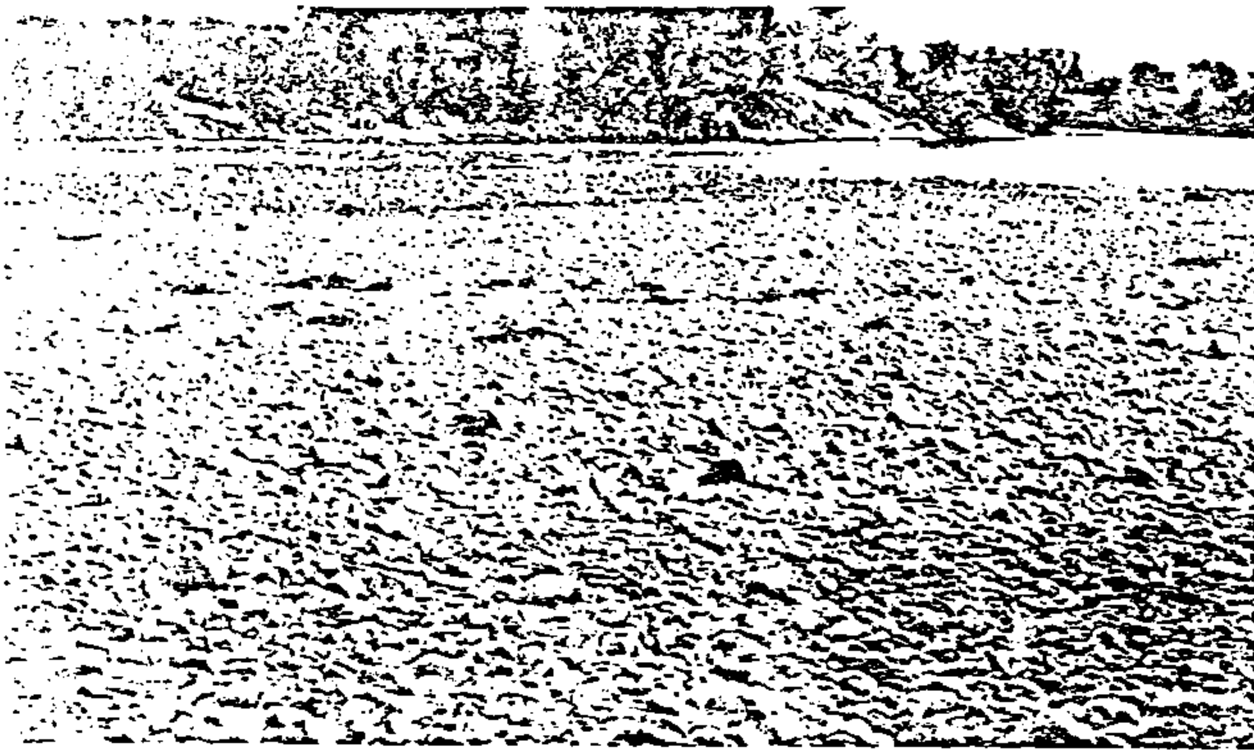
The effect of the Folsom Project upon temperature during the early spawning period is unclear. Rich and Leidy (1985) found no correlation between flow and temperature in early October through November. However, they suggested that higher flows than those investigated would be needed to reduce temperatures earlier. The Bureau of Reclamation, however, predicts that flows would be cooler in October and November if Auburn Dam were in operation (USFWS 1984). This suggests that water temperatures in the upper drainage are cooler than those presently associated with flow from Nimbus Dam and that increasing flow could reduce early fall water temperatures in the lower American River.

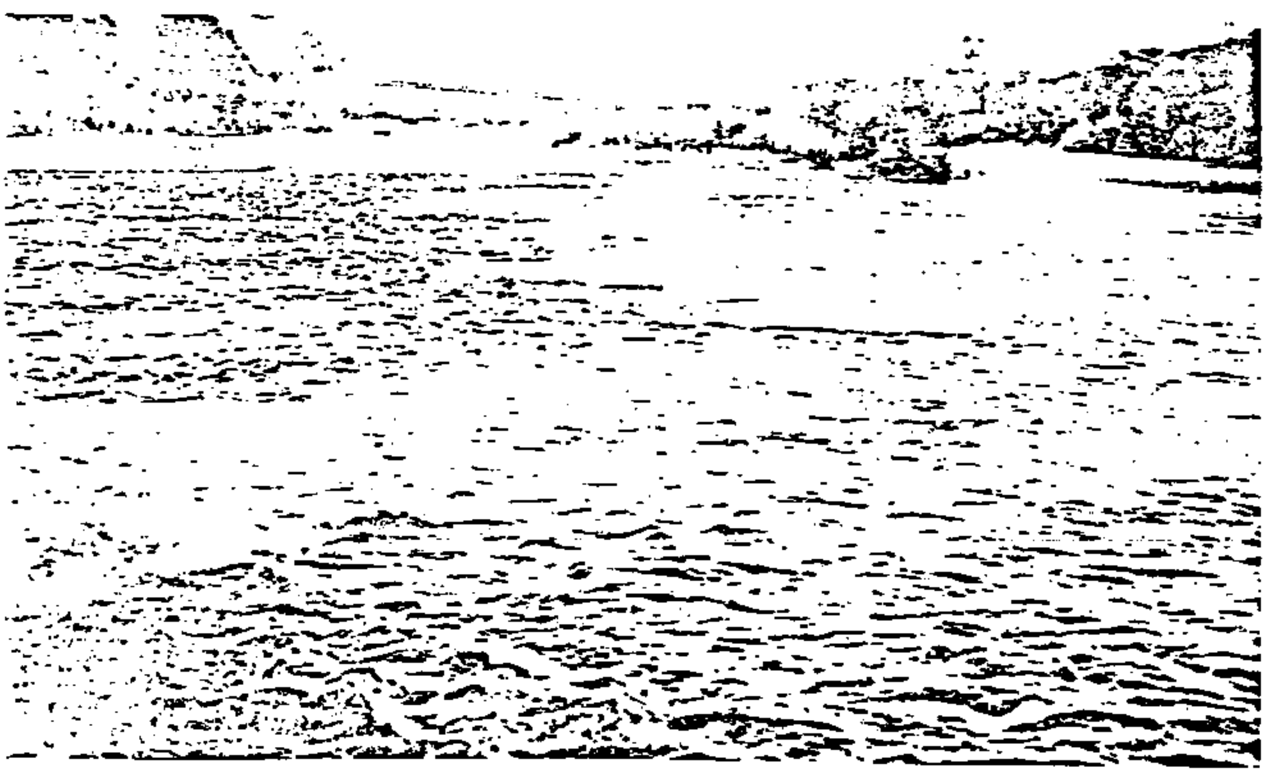
Conclusion

Although available data are inconclusive as to optimum spawning flow requirements, we believe that optimum microhabitat conditions should be provided by flows somewhere between 1,750 cfs (i.e., optimum flow defined by the USFWS study) and 4,000 cfs (i.e., optimum flow based upon the 1966 study). The conditions required to provide amenable water temperatures earlier in the spawning season are unknown. Thus, in order to meet the policies and goals of the State and provide for optimum natural production of salmon in the lower American River, further investigation of the relationship between spawning habitat and flow must be made. An interim alternative to further investigation, is to qualitatively attempt to mimic natural conditions based upon the assumption that the average fall flows during the past 30 years are capable of sustaining salmon production occurring during that period. Based upon this assumption, spawning flows should be maintained at or above 2,200 cfs.

Incubation Flow Requirements

Flows required to maintain eggs and alevins are called incubation flows. None of the previous studies objectively evaluated the conditions required to sustain incubation. However, each study did consider incubation by making various assumptions relating spawning flow to incubation flow. Gerstung (1971) concluded that spawning flows should be maintained until July 15, assuming spawning flows would sustain incubation and juvenile rearing. USFWS (1985) recommends sustaining flow at 1,250 cfs after January 1 to maintain incubation. This recommendation was based upon the assumption that a 500 cfs reduction would decrease water depth only 5 inches, and that even redds built at the minimum depth (0.5 ft) would still





Chinook salmon spawned in extremely shallow water at Sailor Bar when preferred spawning substrate was apparently too shallow or dry at 1,500 cfs. Photos courtesy of Sacramento County by D. C. McKee.

be covered by 1 inch of water. Kelley et al. (1985) concluded that water would remain at least 2 inches deep over redds in the Sailor Bar study site if flows were reduced from 1,750 cfs to 1,250 cfs. He further concludes that this depth should be sufficient to sustain incubation if all other incubation requirements are met. There is no evidence, however, that such requirements would be met at 1,250 cfs.

Maintaining spawning flows to sustain incubation is commonly practiced in Washington state. This practice may appear conservative, but without sufficient information to the contrary, it is considered the most appropriate. Furthermore, sustaining spawning flows through March would not only afford high egg and alevin survival, it will accommodate spawning through the entire, potential spawning period. Since spawning has occurred through January, it seems inappropriate to reduce spawning flow January 1. During the 18 year period between 1960 and 1978, amenable, spawning temperatures didn't occur until mid November in 12 years (66%) and not until December in 5 years (28%). If spawning flows are provided only until January 1, the opportunity for successful spawning is reduced to less than 4 weeks nearly 1 out of 3 years.

Another critical factor affecting incubation is scour. Hecht (1984) reported that flow in excess of 25,000 cfs can result in scour and the potential destructon of redds. Although it is difficult to predict and control conditions resulting in scour, every attempt should be made to preclude flows over 25,000 cfs between October and March.

Rearing Flow Requirements

Optimizing smolt production is considered the best way to optimize salmon production. Spawning and incubation conditions should be maintained to produce enough fry to fully use optimum rearing conditions. In other words, the goals of the State should be met when salmon production is limited by optimum levels of rearing habitat.

Rich and Leidy (1985) and Kelley et al. (1985) have summarized information on rearing habitat as it applies to the lower American River. They agree that the key factors affecting rearing habitat production are living space (microhabitat conditions), temperature and food production. They conclude that there isn't enough information to clearly define the conditions required in the lower American River to optimize juvenile salmon production.

Typically, when salmon fry emerge, they occupy the quiet water along the river edge, unable to swim against a very fast current (Briggs 1953). Those that enter the faster current in the lower American River, are probably swept downriver into slower moving water downstream of H Street, or all the way to the Sacramento River thence the estuary. The residence period of fry remaining in the American River is influenced by a variety of factors including stream discharge (e.g., frequency of freshets), water temperature, food availability, physical habitat availability and density dependent behavior. Ideally, young salmon remain in the river until 3.0 to 3.5 inches long, considered minimum size for a fish to become a smolt and start downstream migration. Several key questions need to be answered concerning this period of a salmon's life in the American River:

1. What flow is required to sustain optimum temperatures, physical habitat and food producing habitat?

2. What is the optimum temperature range providing optimum growth under the conditions potentially available in the lower American River?

3. What consitutes optimum physical habitat and where does it occur under the varying flow conditions presently and potentially occuring in the lower American River?

4. What constitutes optimum food production habitat?

5. What conditions (i.e., photoperiod, fish size, flow, etc.) are required to initiate timely downstream migration?

6. What is the relative contribution of juvenile salmon remaining in the lower American River versus those immediately moving to the Sacramento River after emergence?

Microhabitat Requirements

The USFWS study used the IFIM to identify rearing habitat changes relative to flow (USFWS 1984). The results indicated that rearing habitat reached maximum levels between 500 and 750 cfs. However, since these low flows would not provide amenable rearing water temperatures, they have tentatively recommended that flows be maintained at 1,250 cfs between January 1 and June 30 to sustain suitable rearing conditions.

There has been much discussion as to the appropriateness of the USFWS IFIM results to define rearing habitat conditions. Most notably, the study did not consider cover as a microhabitat variable. Salmonid preference for other microhabitat variables, including water depth and velocity and substrate, is affected by the presence of cover (Glova and Duncan 1985). Salmonid microhabitat preference cannot adequately be described just in terms of velocity and depth, as was the case with the USFWS study. Based upon this fact alone, the results of the USFWS study should be carefully reevaluated before any conclusion is made concerning rearing flows.

To be effective, an IFIM study should be designed to represent all portions of the river. Besides establishing study sites to represent hydraulic conditions throughout the river, habitat preference data should be collected from all portions of the river to clearly define the conditions preferred by the target species, in this case juvenile salmon. The USFWS recognized this need in their draft report by indicating that further investigation into the preference of American River salmon for rearing habitat is needed.

Kelley et al. (1985) also investigated the microhabitat requirements of American River salmon. They concluded that there is a definite interdependent relationship between velocity, depth and substrate, which also acts as cover, and fish preference. His studies further substantiate the need to better define salmon preference before using the IFIM to predict rearing habitat availability.

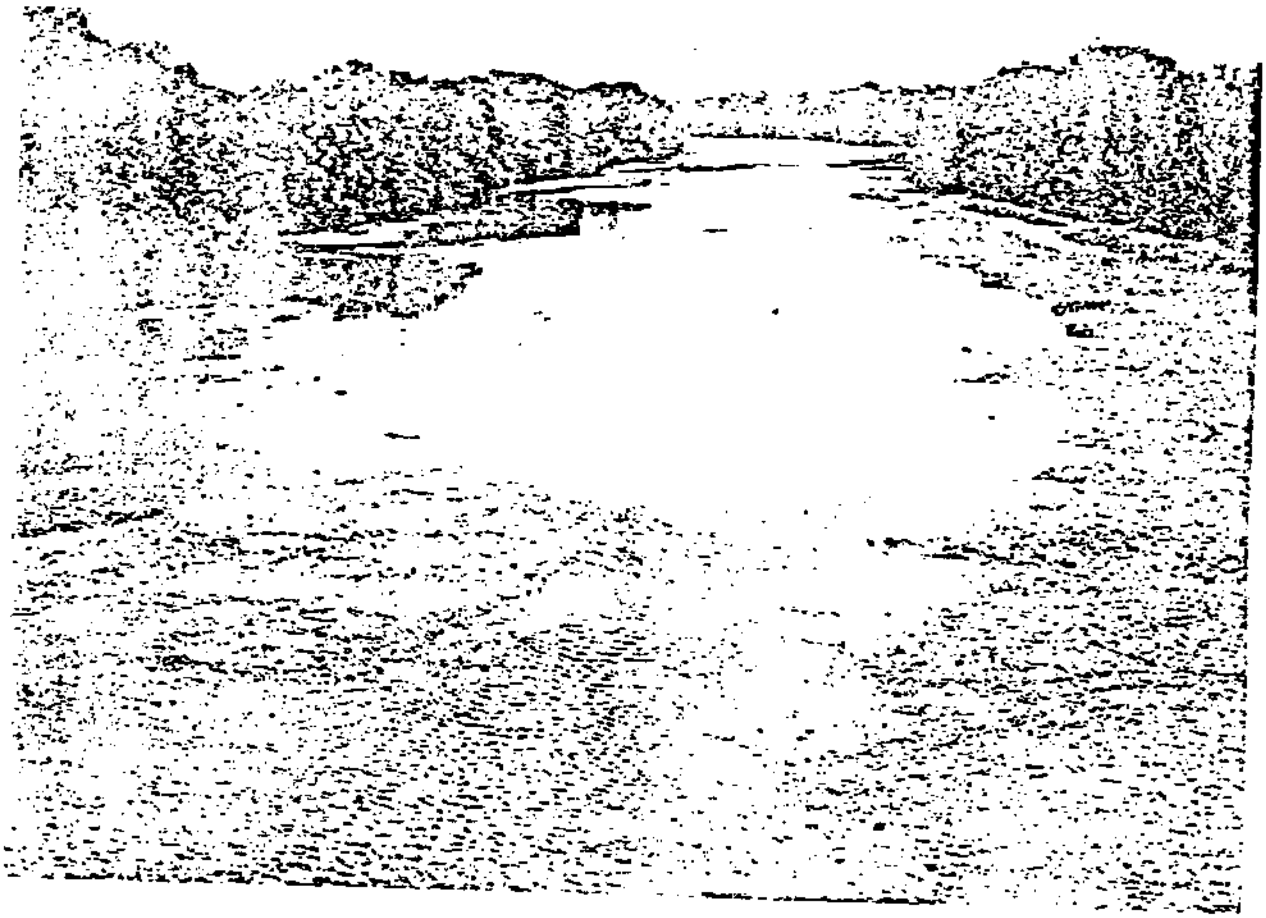
Macrohabitat Requirements

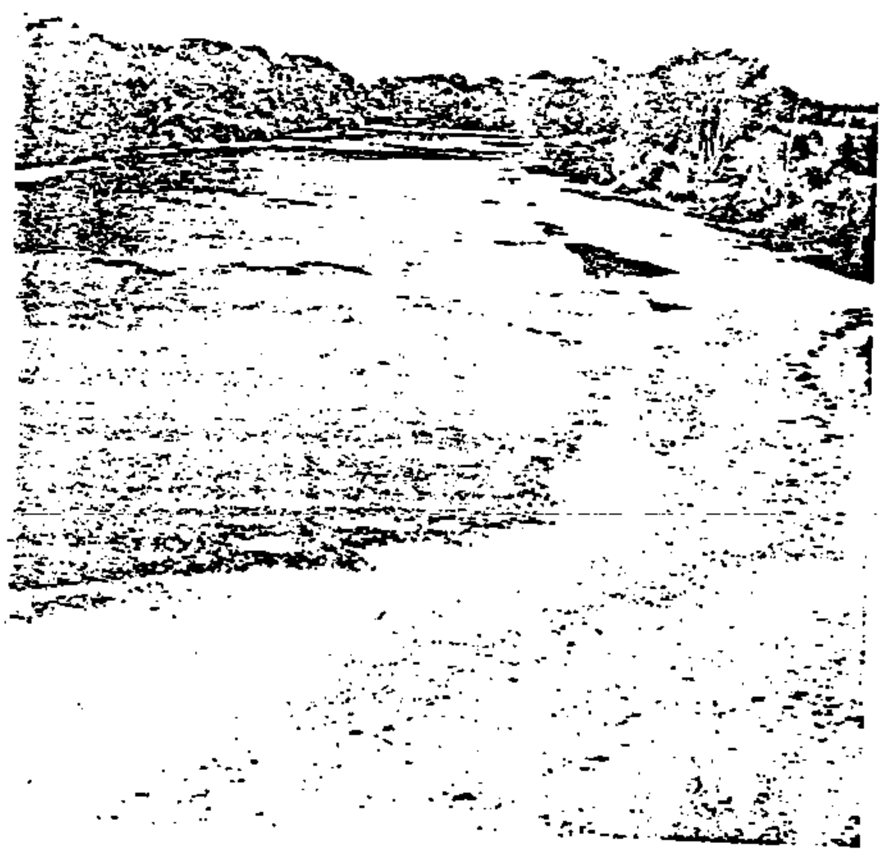
Temperature and food production are critical elements of rearing habitat. Good growth conditions which result in production of numerous, large smolts, directly affects survival and the eventual production of adult salmon. There is some disagreement as to what conditions will provide optimum growth and survival. The USFWS (1985) established 65F as a maximum, optimum temperature; Rich and Leidy (1985) concluded that temperatures in excess of 60F should be avoided. Since there is a definite relationship between spring flow and temperature, most discussion surrounding rearing flows has dealt with temperature rather than microhabitat. These two conditions cannot be discussed independently. Since flow affects food production by affecting temperature and food producing habitat, and since salmon growth, thus survival, is a function of temperature and food production, both temperature and food producing habitat should be evaluated relative to flow simultaneously.

Post-Folsom Project Rearing Habitat Conditions

In the past 30 years, the average flow during the typical rearing period, February through June, has ranged from 3,332 cfs to 5,762 cfs, averaging 4,330 cfs. We attempted to correlate the flow conditions with salmon production using escapement as an indicater of production. Unfortunately, due to the various problems associated with escapement estimates, as discussed above, we determined that such an evaluation would be unreliable.

Rich and Leidy (1985) evaluated temperatures available under various flow conditions between 1973 and 1978, relative to spawning, incubation and rearing requirements. They concluded that the minimum flow regime providing an amenable combination of spawning, incubation and rearing temperatures could not be determined at this time. However, they noted that the flow regime present during the second drought year, 1976-1977, was too low to provide suitable rearing conditions; high temperatures delayed successful spawning until December, and emergence until mid-March. Rearing habitat was theoretically eliminated, since rearing temperatures exceeded optimum levels by the time emergence was complete. Thus, the flow conditions during the spring of 1977 (i.e., average flow was less than 500 cfs), are considered too low to provide optimum rearing. This conclusion is corraberated by results of a tagging study conducted in the upper Sacramento River, at the Tehama-Colusa Fish Facility, and by spring trawl data collected in the lower Sacramento River used to determine smolt abundance. Smolt sized salmon tagged and released near Colusa in spring 1976, yielded only 35% as many adults to the ocean catch as similar fish released in spring 1978 when spring flow in the Sacramento River was markedly higher. Similarly, the catch-per-unit-of-effort of trawl sampling was drastically lower in spring 1977 than in any other sample year.





Watt Avenue at 250 cfs (upper), 500 cfs (lower), 1,250 cfs (oppo[illegible]

Although these results are not directly related to conditions in the lower American River, they suggest that the conditions in the entire Sacramento River system during the second drought year were not conducive to salmon rearing and survival.

Conclusions

Juvenile chinook salmon rearing and smolt production is dependent upon a number of interdepndent habitat conditions, all of which are directly related to flow. Smolt abundance is a function of microhabitat availability, which is dependent upon flow. Smolt size (growth) which affects survival, is affected by temperature and food production, both of which are affected by flow.

The only data that suggest a relationship between flow and rearing habitat is derived from the 1976-77 drought. The unacceptable temperatures associated with the 1976-77 flow regime substantiate that a 500 cfs average flow would not provide optimum rearing habitat. If we were required to prescribe a flow regime capable of maintaining salmon production at existing levels, we would simply relate average flow conditions to average salmon production and identify 4,800 cfs as the required, minimum flow. We do not believe that this is a proper way of identifying optimum flow conditions. However, assuming optimum rearing habitat conditions occur when flow conditions mimic natural conditions, and since high spring flows accommodate this assumption, we believe it safe to assume that flow in the vicinity of 3,000 to 6,000 cfs would conceivably provide optimum rearing.

Emigration Flow Requirements

Emigration from the lower American River is influenced by a variety of factors including conditions in the lower American River and the Sacramento River and its estuary. These conditions can only be qualitatively defined. Further investigation would be required to provide quantitative requirements. Kjelson et al. (1981) did find that fry survival was a function of flow in the upper Sacramento River. Fry stocked in the upper Sacramento River when spring flow was 30,000 cfs survived at much higher rates than fry planted in the upper Sacramento River when spring flow was 10,000 cfs. There is speculation that the relationship between flow and temperature is the key to survival in the upper Sacramento River.

CONSIDERATION OF STEELHEAD RESOURCE HABITAT REQUIREMENTS

Since the completion of the Folsom Project in 1955, natural production of steelhead has been restricted to winter and fall run fish. Both adult and juvenile steelhead contribute significantly to the lower American River sport fishery.

Typically, adult steelhead enter the lower American River beginning in late August. The peak of the run arrives in January. Spawning usually begins in late December, and may last through March. Fry emergence generally peaks in April. Upon emergence, fry tend to move to the quiet water associated with the stream margin (Briggs 1953: Shapovalov and Taft 1954). They soon move to the faster water of the riffles, generally more central in the stream, seeking optimum feeding stations. When the young fish have grown to about 4 inches, they seek slower, deeper water. Juvenile steelhead spend one to two years in the river before migrating to the ocean. Their rearing habitat conditions must be sustained year-round to promote natural production.

Naturally produced steelhead spawners account for less than 5% of the American River run. Low survival of juvenile steelhead, due to a scarcity of amenable habitat conditions throughout the summer, predation and a high harvest rate by summer anglers, are the reasons for the low contribution. None-the-less, the flow requirements of steelhead should be considered because they provide a significant trout fishery.

Microhabitat Requirements

Steelhead microhabitat requirements are similar to salmon. Spawning occurs later and preferred spawning and rearing substrate composition and water velocitiy are slightly different. The critical difference, however, is the required duration of rearing habitat. Steelhead require amenable habitat conditions year-long, salmon only require such conditions until the end of June. The flow required to sustain optimum rearing habitat is unknown.

Macrohabitat Requirements

Basically, temperature limits steelhead rearing habitat during the summer. Most of the existing amenable summer habitat occurs in the upper reaches of the river, near Sailor Bar.

Conclusions

Due to the general similarities in habitat requirements between salmon and steelhead, and due to the potentially impossible task of improving summer habitat conditions, we have determined that by sustaining salmon habitat at optimum levels, and by sustaining existing summer flow conditions, the steelhead fishery in the lower American River will be maintained.

CONSIDERATION OF AMERICAN SHAD HABITAT REQUIREMENTS

Adult American shad typically enter the American River during their annual spawning migration, from mid-May through the first week of July. Shad generally spawn in Central Valley streams when water temperatures are between 60 and 70F. American River water temperatures usually do not reach 60F until late May.

Shad spawn by broadcasting their eggs into the current. The eggs are semi-bouyant and typically drift with the current until hatching. Since they generally hatch within 4 to 6 days, most eggs spawned in the American River do not hatch until they enter the Sacramento River. Few juvenile shad have ever been collected in the American River (Painter, Wixom, and Taylor 1977).

Even though the American River may not sustain many shad juveniles, its contribution as a spawning stream to the overall shad fishery appears significant. Painter et al. (1977) estimate the average shad run to vary from 1.7 to 2.3 million fish. The American River provides spawning for as much as 35% of the run (500,000 fish). Furthermore, the shad fishery is a very popular fishery sustaining about 36,000 angler days and yielding as much as 37,000 fish.

Stream flow directly influences the size and location of shad spawning runs. Run size in the American River and other Sacramento River tributaries depends upon the relative volume of flow in each river during the run (Painter et al. 1977). When the outflow of the American River is high relative to flow in the Sacramento River, the shad run is above average. The converse is also true. During the past 20 years, American River shad runs were good when its flows comprised 25% or more of the Sacramento River flow. During dry years, when the American River contributed less than 7% of the Sacramento River flow, its shad runs were correspondingly low. Since Sacramento River outflow during May and June is generally 15,000 cfs or more, flow in the American River should range from 3,000 to 4,000 cfs to accommodate attraction and sustain the shad fishery.

Streamflow also affects juvenile shad production in the Sacramento River, below the American River. The number of young shad sampled during good stream flow years is significantly greater than the number collected during poor flow years. Analysis of 1967 - 1975 midwater trawl catches show a positive correlation between June inflow into the Delta and shad abundance.

Conclusions

Based upon the requirement for large attraction flows to sustain the American River shad fishery, we conclude that flow in May and June should be maintained between 3,000 and 4,000 cfs. Furthermore, due to the abundance of spawning in the American River, and due to the restrictive optimum spawning temperature range, water temperatures should be maintained below 70F. Since the relationship between temperature and flow is poorly defined, we believe that the safest approach to sustaining optimum temperatures is to mimic the average conditions which have apparently satisfied this requirement in the past, i.e., flows greater than 3,000 cfs.

CONSIDERATION OF STRIPED BASS RESOURCE HABITAT REQUIREMENTS

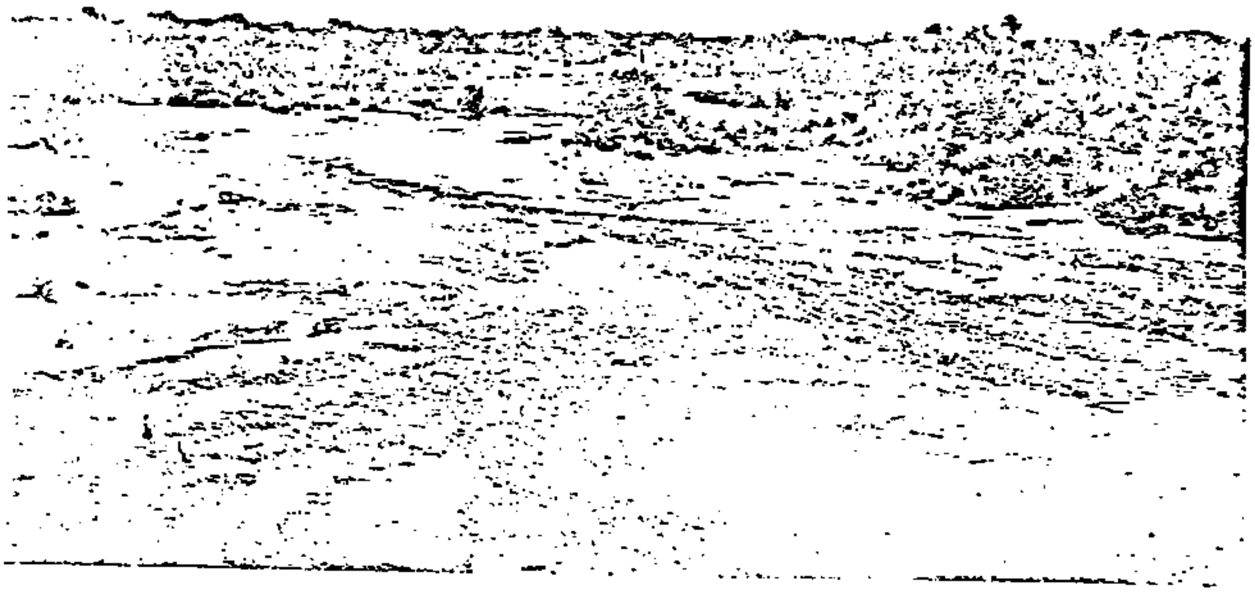
Striped bass occur in moderate numbers in the lower American River from late spring through fall. Although no studies have been made to determine whether striped bass spawn in the lower American River, the scarcity of ripe adults among sport caught fish suggests that spawning, if it occurs at all, is not significant (Dehaven 1978). The American River does appear to be a heavily utilized nursery area for young striped bass. Schools of 5 to 8 inch bass are numerous in the lower river throughout the summer. Substantial numbers of larger bass enter the lower river each spring, with peak migrations coinciding with the May-June striped bass spawning migration up the Sacramento River. The bass are probably attracted to the river in May by the abundance of salmon smolts. A substantial portion of the bass entering the American River remain through the fall.

Attraction flows in the lower river during May and June, and food production are important factors influencing striped bass abundance. Low stream flows such as those occurring in 1977 (500 to 1,100 cfs through the summer) negatively affected striped bass abundance in the lower American River. During that year, few striped bass were caught upstream from Arden Bar and few bass were present in the lower river during the late summer and fall (Dehaven 1977). In general, higher flows are probably more conducive to greater food production and holding fish in the lower river for a longer period. However, the most important factor determining the number of striped bass in the lower American River is the size of the overall Bay-Delta striped bass population. The importance of the American River to the Bay-Delta striped bass population at present is not well understood. With respect to recommended flows for striped bass fishery maintenance in the lower American River, the D1400 flow schedule (1,500 cfs during the summer) should be sufficient to maintain the fishery at present levels.

GENERAL CONCLUSIONS ABOUT FISH FLOW REQUIREMENTS

Chinook salmon sustain the most important fish resource in the lower American River, based upon its economic and recreation attributes. This significance must be reflected in developing flow requirements for the lower American River. Additionally, in order of priority, the flow requirements of the American shad fishery, the river's second largest sport fishery, the steelhead and striped bass fisheries and the various game and nongame fish resources should be accommodated. It is in the best interest of the people of Sacramento County and of the State, that these resources continue to contribute to one of California's most valued river resources. This can only be accomplished if the flows required to sustain optimum habitat conditions are clearly identified, then guaranteed through a comprehensive agreement between all parties concerned.

This report provides a starting point for identifying the flows needed to preserve the fish resources of the lower American River and meet the



San Juan rapids, located near stream-mile 17, at 500 cfs (upper), 1,250 cfs (lower) and 2,500 cfs (opposite). Photos courtesy of USFWS.

management policies and goals of the State. We have identified a range of flows which should encompass optimum flow requirements of the lower American River fish resources (Figure 2, Table 1). The magnitude of these flows was based upon limited data and the assumption that mimicing natural flow conditions occurring during the past 30 years, would sustain optimum habitat conditions. However, such an assumption may be invalid. Therefore, we recommend that the flow requirements of these resources be thoroughly investigated during the next 3 to 5 years so that a more definitive flow regime recommendation can be made.

TABLE 1. Flow Ranges Encompassing the Flow Regime Required to Sustain Fish Resources in the Lower American River.

Period	Flow range	Critical habitat condition accommodated
Oct 15 - Mar 1	1,750-4,000 cfs	Salmon and steelhead spawning and incubation
Mar 1 - Jul 1	3,000-6,000 cfs	Salmon and steelhead rearing shad migration
Jul 1 - Oct 15	1,500 cfs	Steelhead and trout rearing

We believe that the flow required to optimize salmon spawning is somewhere between 1,750 and 4,000 cfs, and that spawning flows should be maintained between mid-October and February to guarantee successful incubation. However, we do not know what flows are required for optimum salmon rearing; such flows should optimize rearing habitat in terms of microhabitat, temperature, food production and emigration. We have tentatively identified these flows as being between 3,000 and 6,000 cfs. Furthermore, we know that flows in the vicinity of 3,000 cfs are required in May and June to provide optimum American shad immigration into the lower American River. We believe that flows providing for optimum salmon production will at least partially sustain the steelhead fishery at least through June, and that flows required for shad will sustain the striped bass fishery.

We are currently developing a study plan for the lower American River to answer the questions concerning the flow dependent habitat requirements of its aquatic resources. The major areas that will be covered in the study are:

1. Spawning habitat requirements, including the relationship between flow and temperature, microhabitat, gravel recruitment and channel morphology.

2. Incubation flow requirements.

3. Rearing habitat requirements, including the relationship between flow and temperature, food production, microhabitat, gravel recruitment and emigration.

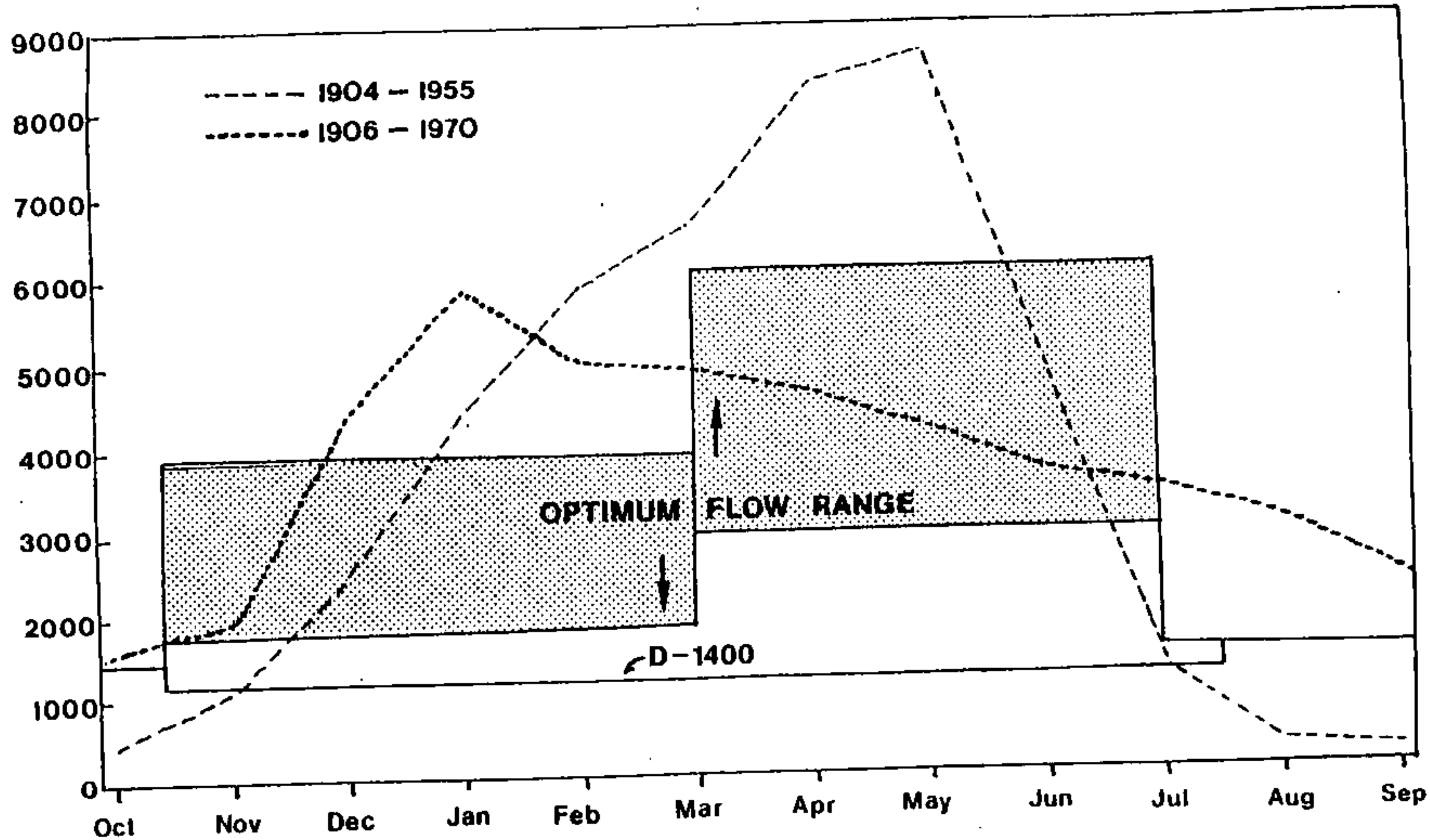


FIGURE 2. Comparison of the flow range identified as encompassing optimum habitat conditions with pre- and post-Folsom Project mean monthly flows and Decision 1400 flow requirements. Lower American River, California.

4. Influence of American River discharge upon the aquatic habitat of the Sacramento River, especially in reference to temperature and rearing habitat.

5. Existing and potential impact of water development upon the geomorphology of the lower American River.

CONSIDERATION OF RIPARIAN WILDLIFE HABITAT REQUIREMENTS

The 23 mile long stretch of the American River downstream from Nimbus Dam contains approximately 4,800 acres of flood plain. The flood plain occupies lands inundated by maximum project design releases of 115,000 cfs. The adjoining cities, the County of Sacramento and the State Reclamation Board have jurisdiction over encroachments within the floodway. Historically, the flood plain of the American River encompassed at least 10,000 acres of lowlands. A vast area in the vicinity of North Sacramento typically flooded during heavy runoff periods. An extensive system of levees followed by flood control storage at Folsom Dam in 1955 has permitted the reclamation and urbanization of most of the overflow lands. Of the remaining floodlands within the levee system, approximately one-fifth are covered with cottonwood and oak woodlands. Originally, this woodland covered most of the better-drained portions of the flood plain. Gold dredging, clearing for agriculture, flood control practices and urbanization are largely responsible for the decrease in trees.

Grasses, including cultivated pasture, occupy a little more than one-third of the flood plain area. Herbaceous plants and shrubs cover about one-fifth of the flood plain. Bare sand and gravel comprise about 10 percent of the flood plain while river and pond surfaces cover the remaining flood plain area.

The banks of the American River typically are lined with willow thickets which extend into areas often submerged by winter flows. At slightly higher elevations along the stream bank, typical riparian tree growth includes California sycamore (Platanus racemosa), Fremont cottonwood (Populus fremonti), Oregon ash (Fraxinus latifolia), white alder (Alnus rhombifolia), willows (Salix spp.) and valley oak (Quercus lobata). Within the shade of these trees an understory of shrubs, vines and forbs form a dense cover down to the water's edge. These include horehound (Marrubium vulgare), mints (Mentha spp.), nightshade (Solanum spp.), horestails (Equisetum spp.), blackberry (Rubus spp.), wild grape (Vitis californica), elderberrys (Sambucus spp.), California mugwort (Artemisia vulgaris) and ragweed (Ambrosia spp.). This growth is particularly important to wildlife as cover. Along the drier uplands and river bluffs common species include interior live oak (Quercus wislizenii), California buckeye (Aesculus Californica), blue oak (Quercus donglasii), black locust (Robinia pseudo-acacia), black walnut (Juglans hindsii), digger pine (Pinus sabiniana), coffeeberry (Rhamnus californicus), lupine (Lupinus spp.), redbud (Cercis occidentalis), scotch broom (Cytisus scoparius), wild rose (Rosa californica), yerba santa (Eriodictyon californicum), toyon (Photinia arbutefolia), coyote bush (Baccharis pilularis) and poison oak (Rhus diversiloba). Most of the riparian species are dependent on a high water table. The mature oaks and cottonwood add greatly to the beauty of the river. Attractive groves of these trees are found in the Fair Oaks area. A substantial portion of the woodland along the river has been preserved in the County park system.

In the early 1800's Russian explorers came up the American River in search of furbearing animals. They first recorded the name of the river as the "River of the Hunters." In 1828, Captain Jedediah Smith and a party of trappers explored the American River keeping careful records of observations. Captain Smith's journal mentions the abundance of wildlife along the river.

At that time vast herds of tule elk (Cervus canadensis) inhabited the riparian lands along the American River. Antelope (Antilocapra americana) and black-tailed deer (Odocoileus hemionus columbianus) were abundant on the uplands. The California grizzly bear (Ursus horribilis) was also a resident here. These species, with the exception of the deer, have long since been extirpated from the area. A few black-tailed deer can still be observed along the parkway.

Despite the encroachments of civilization, many species of wildlife still thrive along the banks of the American River. Members of the Sacramento Audubon Society have observed 200 different species of birds along the river. Many are dependent on the riparian habitat, marshes and ponds created by the river. A moderate number of furbearers still inhabit the river banks. These include beavers, muskrats, minks, raccoons, long-tailed weasels, opossums, ground squirrels, gray squirrels and an occasional river otter. A few gray foxes, badgers, coyotes and bobcats are still occasionally observed. Jackrabbits, moles, gophers and meadow mice are numerous. Cottontail rabbits, brush rabbits and wood rats are less abundant. Common reptiles and amphibians along the lower American River include the bullfrog (Rana catesbeiana), Pacific treefrog (Hyla regilla), western toad (Bufo boreas), common king snake (Lampropeltis getulus), gopher snake (Pituophis melanoleucus), garter snakes (Thamnophis spp.), southern alligator lizard (Gerrhonotus multicarinatus), western fence lizard (Sceloporus occidentalis), western skink (Eumeces skiltonianus) and western pond turtle (Clemmys marmorata).

Also found along the river are four species of special concern: Swainsons hawk (Buteo swainsoni), bald eagle (Haliaetus leucocephalus), peregrine falcon (Falco peregrinus) and valley elderberry longhorn beetle (Desmorcerus californicus dimorphus). The Swainsons hawk is listed by the State as rare. The bald eagle and peregrine falcon are listed as endangered and the valley elderberry longhorn beetle is listed as threatened under the Federal Endangered Species Act. Swainsons hawks have nested along the lower American River near Discovery Park. A few rare sightings of peregrine falcons have been made in the parkway. The bald eagle is a regular winter visitor to Folsom Lake. Occasionally, the eagle has been seen along the lower American River, upstream from the Watt Avenue Bridge, foraging on salmon carcasses. Valley elderberry beetles are found along the lower river parkway where its host plant, the elderberry plant occurs. Essential and critical habitat has been identified along the parkway by the USFWS.

Several portions of the American River, near Carmichael, are used as nature areas. Trained naturalist-guides and volunteers conduct thousands of young students through these natural preserves as part of the County's education program.

Many amateur naturalists observe and study birds, mammals and plants along the river. Students from high school and college classes and members of the Sacramento Audubon Society and other nature groups also spend a considerable amount of time observing wildlife along the river.

Limiting or reducing the flood flow regime below Nimbus Dam will greatly affect the riparian ecosystem of the lower American River. Existing lower American River floodflows allow deposition of nutrients and sediments which nourishes the riparian plant community. Seasonal floodflows induce movement of point bars and provide a natural, scattered serial stages of riparian vegetation from sandy point bars with young willows to subclimax and multi-layered climax riparian vegetation. The present stream flow regime maintains the water surface area of American River providing an aquatic habitat for many water dependent wildlife, such as beavers, muskrats, kingfishers, etc.

Riparian vegetation has evolved with and is responsive to changes in floodflows. Reduced floodflows lessen the scouring of point bars and islands along the river and lowers the water table in adjacent wetlands (i.e., ponds and marshes), adversely affecting water dependent aquatic life. However, reduced scouring of the river floodway and lowering the water table in adjacent wetlands allows willows and cottonwood trees to encroach into these areas; thereby, partially compensating for some of the vegetation loss. A more significant change could occur in riparian vegetation if D893 flows occur. During the 1976-77 drought, when D893 flow levels occurred, some ponds and backwaters dried up and some riparian vegetation died as the adjacent water table dropped. Even though impacts of a long term reduction in flow cannot be predicted at this time. Some change in willow distribution is likely to occur.

The Swainsons hawk and peregrine falcon's use of the lower American River Parkway is not expected to be affected by vegetation changes associated with reduced straem flow or reduced floodflows. Little change is expected to occur in bald eagle numbers, even with a decline in the anadromous fishery, since the eagle population is so small that even reduced anadromous fish numbers should provide an adequate food source. The impact upon the valley elderberry longhorn beetle is more difficult to predict. The beetle is endemic to the moist valley oak-riparian woodlands along the waterways in the lower Sacramento and lower San Joaquin valleys where its food source, the elderberry plant grows. Although it is anticipated that change in floodflows would have little impact upon the mature elderberry plants, subtle, longterm reductions in elderberry abundance could occur. Since elderberrys are limited in the dry valleys to flood plains, it is assumed floodflows create an environmental condition favorable to germination and survival of elderberry seedlings. If this assumption is true, elderberry recruitments may decline which would impact the dependent valley elderberry long-horn beetle.

Recommended late spring flows of 3,000 to 5,000 cfs along with summer flows of 1,500 cfs, in conjunction with periodic flood flows, should be adequate to maintain the riparian vegetation growth bordering the river and adjacent ponds backwaters and wetlands.

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Slower, deeper habitat conditions occur from H Street, downstream. (DFG photo by G.E.Smith)