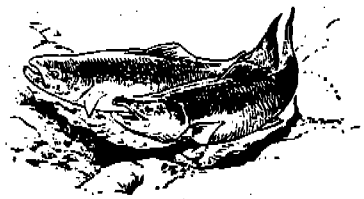
Life Stage Periodicities of Anadromous Salmonids in the Klamath River Basin, Northwestern California



LIFE STAGE PERIODICITIES OF ANADROMOUS SALMONIDS

IN THE

KLAMATH RIVER BASIN, NORTHWESTERN CALIFORNIA

by
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April 1984

INTRODUCTION

The purpose of this report is to consolidate into a single reference, known life stage periodicities for chinook salmon (Oncorhynchus tshawytscha), coho salmon (O. kisutch), and steelhead trout (Salmo gairdnerii gairdnerii) in tributaries of the Klamath River system, California (Figure 1). Until now, information on life stage periodicity for these anadromous salmonids in this river system was widely scattered among government resource management agencies, a condition that has caused confusion between private development interests and government agencies concerning the management needs of the fishery resource.

In recent years private interests have advanced numerous proposals to develop the basin for small-scale hydroelectric power generation, timber harvesting, and mineral extraction -- with associated water withdrawals and road construction. Although these development activities are not without adverse implication for the larger rivers within the system (e.g., Klamath and Trinity), there is general recognition by resource managers that anadromous salmonid habitat in the smaller tributaries is likely to suffer a greater adverse impact. Much of the resource management concern has focused on proposals to construct small-scale hydroelectric generating facilities on the Klamath River basin's smaller tributary streams, some of which are important spawning and nursery habitats for anadromous salmonids. Many proposed development activities would directly affect public lands, and all would affect the publically owned fishery resource.

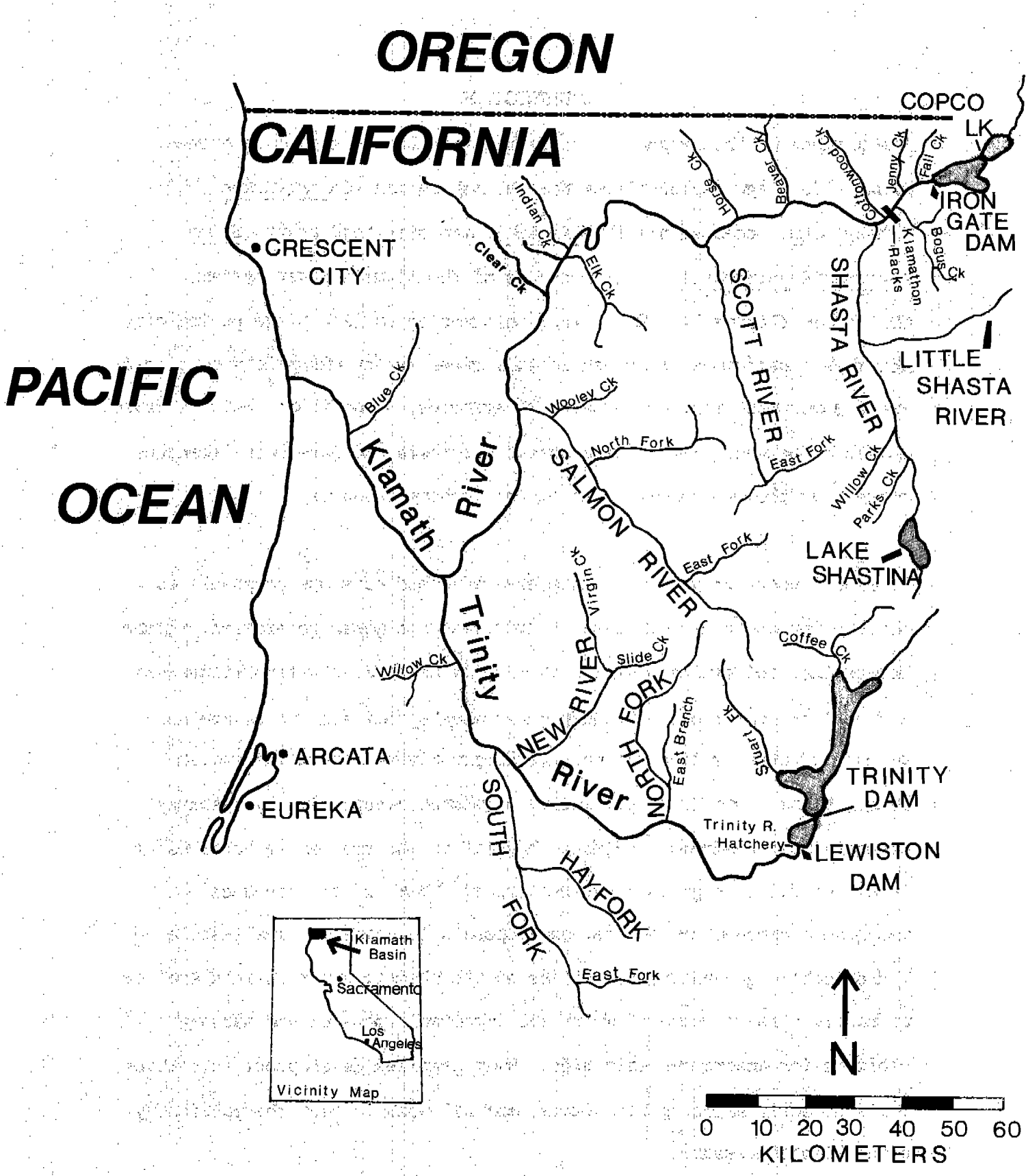


FIGURE 1. KLAMATH RIVER BASIN, NORTHWESTERN CALIFORNIA

In anticipation that development pressure will continue to grow, and in order to improve the prediction of potential impacts of proposed hydroelectric projects, personnel of the U.S. Fish and Wildlife Service, U.S. Forest Service, California Department of Fish and Game, and several private consulting firms, met to discuss anadromous salmonid life stage periodicities. This report is a result of those discussions and is intended to serve as an initial step in reducing confusion surrounding the time of occurrence of life history events in various salmonid runs (races, populations) in tributaries of the Klamath River system.

METHODS

Discussions among participating resource managers familiar with the life history events of anadromous salmonids in the Klamath River drainage resulted in the construction of the life stage periodicity tables in this report. The data presented in these tables represents the collective knowledge and experience of all meeting participants (Appendix A). Each participant was asked to review and comment on the charts when in draft form and their suggested changes were subsequently incorporated. Also, a review of the unpublished and published literature on Klamath River fisheries was undertaken for the purpose of gleaning additional data on the timing of life history events. Several tables were modified slightly based on the literature review.

Because of temporal variability in the life stage periodicities of different runs (and even variability within a run) in the tributaries of the drainage, the periodicity tables have been organized on the basis of segments of the larger streams (Tables 1-14). As used in this report, the lower Klamath River includes tributaries from the mouth to the confluence of the Trinity River. The middle Klamath River includes tributaries from the confluence of the Trinity River upstream to the confluence of the Scott River. The upper Klamath includes tributaries between the confluence of the Scott River and Iron Gate Dam. The lower Trinity River is composed of streams from its confluence with the Klamath River upstream to the confluence of the North Fork Trinity River. The upper Trinity River includes tributaries from the confluence of the North Fork Trinity River to Lewiston Dam.

Information on the distribution and abundance of coho salmon in tributaries of the Klamath River system is very limited. This is due in large part to the relatively small size of the run, occurrence of spawning migrations during high- and turbid-water conditions, and the similar appearance in the water of coho to chinook salmon and steelhead trout. Because of the lack of data on coho salmon runs in specific streams, the life stage periodicity table for this species has not been subdivided by stream segments. Similarily, the occurrence of life history events of different races of steelhead in tributaries of the Klamath River system is not well understood. Adult steelhead enter the Klamath River to spawn at varying ages and the timing of runs and spawning overlap. In addition, spawning activity occurs during high-flow periods in winter

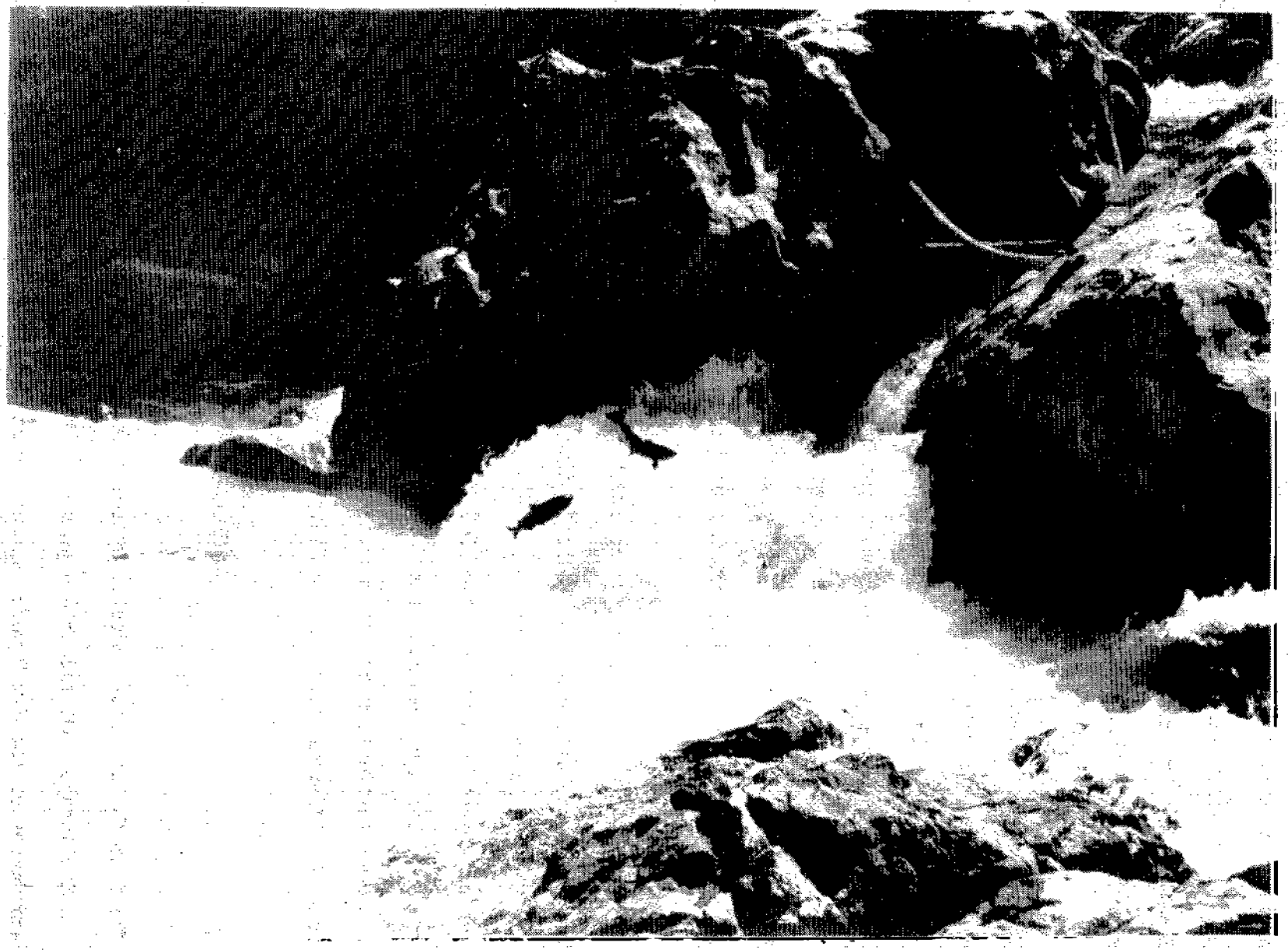
and spring thus making observations difficult. For these reasons, only life stage periodicity data for winter-run steelhead have been presented. However, a brief discussion of the timing of fall- and spring-run steelhead is included in this report.

A small run of coastal cutthroat trout (Salmo clarkii clarkii) spawns in the lower Klamath River tributaries in late winter and in spring (Rankel 1978). There is a general downstream migration of juveniles during their development, with most reaching the ocean at two to four years of age (Rankel 1978). Cutthroat trout may spawn more than once. Because of the lack of data on the time of occurrence of life history events, a periodicity table has not been developed for this species.

It is emphasized that this report constitutes the first attempt at consolidating life stage periodicity data on anadromous salmonids in the Klamath River system into a single source. For this reason the tables should be used with the understanding that, as more information is gathered through research, they will require modification to incorporate the best information on the occurrence of life stage events of specific runs in different parts of the Klamath River system.

BACKGROUND

The Klamath River basin drains approximately 40,000 sq km in Oregon and California. Of the 26,000 sq km in California, most is within the boundaries of the Six Rivers, Klamath, Shasta, and Trinity National



Salmon and steelhead have a sensitive navigational capability and uncanny ability to overcome great obstacles in returning to their ancestral spawning ground. Young salmon and steelhead, during their out-migration,must also overcome similar obstacles that impede their way to the ocean.

California Department of Fish and Game Photo

Forests. The Hoopa Valley Indian Reservation, comprising approximately 583 sq km in Humboldt and Del Norte Counties, borders the lower 68 km of the Klamath River and lower 26 km of the Trinity River, the largest tributary in the drainage. The most important anadromous salmonid spawning tributary streams in the basin include the Trinity River, draining approximately 7,690 sq km, and the Shasta, Scott, and Salmon Rivers, each draining approximately 2,100 sq km. Iron Gate Dam on the Klamath River and Lewiston Dam on the Trinity River represent the upper limits of anadromous salmonid migration in the basin, and hatcheries located near the base of each dam (Iron Gate and Trinity River hatcheries) were constructed as mitigation for natural fish production losses resulting from each project (USFWS 1982).

The Klamath River basin has historically supported large runs of chinook salmon and steelhead trout and smaller runs of coho salmon. These have contributed considerably to subsistence, sport, and commercial fisheries in California. Generations of Native Americans have utilized fishing grounds in the drainage, and their fisheries for salmon, steelhead, and sturgeon have historically provided the mainstay of their economy in the area.

Sport fishing for salmon and steelhead in the drainage may exceed 200,000 angler-days annually. Klamath River basin stocks may account for 30 percent of commercial chinook salmon landings in northern California and southern Oregon. These landings averaged approximately 400,000 fish per year in the decade preceding 1982 (USFWS 1982). For the period 1979-1982, commercial ocean landings of chinook salmon attributable to the Klamath River averaged 176,000 fish (USFWS 1982).

In 1980, the Department of the Interior included the Klamath and Trinity Rivers in the National Wild and Scenic Rivers System, largely because of the river's important anadromous fish resource. Portions of the Klamath and Trinity Rivers are also under California state classification as Wild and Scenic Rivers.

The Klamath River system supports the largest coho salmon and steelhead trout runs (including threatened spring-run steelhead) in California, and ranks second to the Sacramento River in the production of chinook salmon. Historically, spring chinook salmon comprised the major run in the Klamath but this run was nearly extirpated in the early 1900's by overfishing and habitat destruction (Snyder 1931). Since then, fall chinook have predominated.

The primary salmon spawning areas in the Klamath River itself are located in a 13-mile section from the mouth of the Shasta River upstream to Iron Gate Dam. Spawning habitat in the main river downstream from the confluence of the Shasta River is scattered and of lesser quality. However, the larger tributaries, including the Trinity (below Lewiston Dam), Salmon, Scott, Shasta, and Little Shasta Rivers, as well as many smaller tributaries, such as Blue, Clear, Elk, Indian, Beaver, Wooley, and Grider Creeks, support significant runs of salmon and steelhead.

Run Sizes

Chinook salmon. Although the major importance of the Klamath River and its tributaries as a salmon and steelhead producer is well recognized, specific information on the size of historical and present-day runs is incomplete in many respects. Rankel (1978) presented a chronological compilation of estimated run sizes by species as reported in the literature. The following discussion of Klamath River fisheries draws heavily from his summary.

Snyder (1931) gave a conservative estimate of 141,000 salmon for the Klamath River fishery catch in 1912, based on a peak cannery pack of over 1,384,000 pounds. Moffett and Smith (1950) estimated that salmon originating from the Klamath River system contributed approximately 200,000 fish annually to the offshore commercial catch between 1916 and 1943. Rankel (1978) combined Snyder's river catch data and Moffett and Smith's statistics on offshore commercial catch to arrive at an estimate of approximately 300,000 to 400,000 salmon comprising the annual catch and escapement for the Klamath River system during the period 1915-1928.

Murphy and Shapovalov (1951) and Holmberg (1972) reported numbers of chinook salmon at counting stations on the upper Klamath River (Klamathon Racks) and the Shasta River. Annual counts at the Klamathon Racks ranged from 2,393 to 33,144 fish ($\bar{x}$ = 12,086) between 1925-1949; 2,000 to 22,000 fish ($\bar{x}$ = 3,000) between 1956-1969. Annual counts at the Shasta River Racks ranged from 11,570 to 81,844 fish ($\bar{x}$ = 43,752)

between 1930-1937; 7,590 to 55,155 fish ($\bar{x}$ = 18,266) during the period 1938-1946; a few hundred to 34,000 fish ($\bar{x}$ = 10,000) between 1950-1969); and 3,641 to 16,032 fish ($\bar{x}$ = 9,328) between 1970-1976.

An estimated 18,000 to 36,000 chinook salmon ascended the Trinity River in 1944 and 1945, prior to the completion of Lewiston Dam (Moffett and Smith 1950). Coots (1967) estimated that the average annual run of chinook salmon entering the Klamath River was 168,000, half of which ascended the Trinity River. In 1960, the U.S. Fish and Wildlife Service reported that annual runs of 100,000 to 125,000 salmon enter the Klamath River system to spawn. The same report, referring to California Department of Fish and Game estimates of 35,000 and 55,000 chinook comprising Trinity River spawning runs in 1955 and 1956, respectively, noted that these estimates probably represented one-third to one-half of the entire Klamath run. Holmberg (1972) refers to historical chinook spawning escapements of 66,000 in the Trinity River drainage and 109,000 for the Klamath River drainage (exclusive of the Trinity River). Burton, Haley and Stone (1977) estimated that chinook escapements in the Trinity River below Lewiston Dam averaged 30,500 annually during the period 1968-1972. Annual adult returns to the Trinity River Hatchery between 1959 and 1980 averaged 6,664 fish. Returns to the Iron Gate Hatchery averaged 5,943 fish during the years 1962-1980. The U.S. Fish and Wildlife Service (1983) estimated average annual fall chinook runs for the Klamath and Trinity Rivers, for the period 1978-1981, at 36,900 and 30,200 fish, respectively. The average spring chinook run in the Trinity River for the same period was estimated at 8,700 fish (USFWS 1983).

Coho salmon. Coho salmon have probably never been as numerous as chinook salmon in the Klamath River system. The distribution and abundance of coho salmon in the system has been difficult to ascertain because of the relatively small size of the run, the occurrence of migrations during high- and often turbid-water conditions, and the similar appearance in the water of coho to chinook salmon and steelhead. Annual spawning escapement of coho salmon to the Klamath River system is believed to range from 15,400 to 20,000 (USFWS 1983). Holmberg (1972) placed coho escapement to the Trinity River at 8,000 fish. Coho salmon counts at Iron Gate Hatchery for the period 1975-1981 averaged 1,357 fish. Returns to Trinity River Hatchery for the period 1973-1980 averaged 3,277 fish.

Steelhead trout. The U.S. Fish and Wildlife Service (1960) estimated the historical mean annual steelhead run in the Klamath River system at 400,000 fish. This included "half-pounders" or sexually immature fish which have spent one to three years rearing in freshwater and less than one year in the ocean before making their first upstream migration. Coots (1967) estimated the Klamath River system run at 250,000 fish. Average steelhead spawning escapement to the Trinity River for the years 1980-1981 has been estimated at 24,000 fish (USFWS 1983). Annual steelhead returns to Iron Gate Hatchery for the period 1963-1981 have averaged 1,725 fish. A tag-recapture program conducted in the lower Klamath River during the 1976-1977 migration yielded estimates of 135,096 adult fall-run steelhead and 504,247 "half-pounders" (Boydston 1977).

Salmon and steelhead have certain defined environmental parameters. A fundamental requirement is water as instream flow of the proper quantity and quality from the spawning areas to the ocean. As juvenile fish, they migrate to the ocean, travel coastal waters and the high seas during their major growth period, but depend upon clean and cool riverine environments for spawning and rearing. California Department of Fish and Game Photo

RESULTS AND DISCUSSION

Life Stage Periodicity

Chinook Salmon

Chinook salmon runs in the Klamath River system occur during the spring and fall. Adult salmon migrate into the Klamath River and spawn primarily at age three and four (USFS 1972). Age five fish comprise a small portion of the run; the numbers of fish older than five is insignificant (USFS 1972). Approximately 5 to 30 percent of the annual run is composed of age-two fish known as grilse or "jacks" (USFS 1972). Virtually all grilse are sexually mature and attempt to spawn. The success rate of grilse in fertilizing eggs is not known.

Fall-Run (Tables 1, 2, 3, and 4)

Fall chinook begin ascending the mainstem Klamath River usually in July and enter tributaries of the lower Klamath River from August through December. Fish begin appearing in tributaries of the middle Klamath in September and continue to migrate through January, while the upper Klamath salmon usually enter the large streams (e.g., Scott and Shasta Rivers) in September and October and the smaller tributaries in November and December. In the Trinity River fish have been recorded in the mainstem as early as July, but they do not generally enter the larger tributaries until September and October and the smaller streams until November and December.

Spawning commences in the larger tributaries of the upper Klamath in mid-September and in the smaller tributaries in November; in the tributaries of the middle Klamath in October; and in tributaries of the lower Klamath in mid-November. Spawning peaks in November in most tributaries of the Klamath River. Spawning in the middle and lower Klamath continues through January, but in the upper Klamath only through December. In the Trinity River spawning in the larger tributaries begins in October and continues through December.

The period of egg incubation begins with the earliest spawning in the system and extends through March in tributaries of the lower and middle Klamath. In the upper Klamath and Trinity Rivers all incubation is usually completed before March.

Emergence takes place in the larger tributaries of the upper Klamath in November and December and in the smaller tributaries in January and February. The period of emergence in tributaries of the Trinty River is similar to that of the upper Klamath tributaries. Emergence in the tributaries of the middle Klamath occurs from December through March in those of the lower Klamath from February through mid-April.

Out-migration occurs from February through mid-June in all tributaries of the Klamath River system.

Spring-Run (Tables 5 and 6)

Spring chinook begin their migration to tributaries of the Klamath and Trinity Rivers in April. In the Klamath River drainage, migration usually does not continue beyond August; however, in the Trinity drainage it lasts through October. The timing of spawning activity is similar in both drainage with most activity in the Klamath occurring in October and November while in the Trinity River system spawning takes place from September through November. Egg incubation begins immediately after spawning and continues through January. Emergence begins in November in tributaries of the Trinity River and December in tributaries of the Klamath, and continues through February. Out-migration of smolts is the same for the entire system, occurring primarily from February through mid-June. In tributaries of both the Trinity and Klamath Rivers spring chinook will hold in deep, cold, permanent pools from June through September prior to spawning.

Coho Salmon (Table 7)

Adult coho salmon migrate into the Klamath River system primarily as age-three fish, usually from mid-September through January (USFS 1972). Coho generally prefer smaller tributaries for spawning than those utilized by chinook salmon (USFS 1972). Spawning occurs from November through January. Egg incubation takes place from November through March. Depending on water temperatures, coho salmon eggs hatch in one to three months, with the emergence of alevins beginning in February and continuing through mid-May. Juvenile coho rear in freshwater for about

one year, usually in small tributary streams into which some have migrated. Out-migration of smolts occurs from February through mid-June, peaking in April and May.

Steelhead Trout (Tables 8, 9, 10, 11 12, 13, and 14)

Adult steelhead migrate into the Klamath River system during every month of the year, with the possible exception of July (USFS 1972). Steelhead spend from one to four years in the ocean prior to their first spawning migration, and may spawn three or four times during their life. The Klamath River system supports at least three runs of steelhead and possibly four. These include fall, winter, and spring runs.

The initial stages of the fall-run is dominated by small migrants, often termed "half-pounders", which migrate primarily from August through October. "Half-pounders" are defined as steelhead less than 40 cm in length which have spent from one to three years rearing in freshwater, and less than one year in the ocean before beginning their first upstream migration (Everest 1971, Rankel 1978). "Half-pounders"are usually immature and migrate back to the ocean the following winter or spring. According to Rankel (1978), this run of immature fish is unusual in that it occurs in large numbers in only a few rivers: the Klamath and Eel Rivers in California and the Rogue River in Oregon.

Progressively greater numbers of larger migrants enter the river in October and November to spawn in the smaller tributaries. This late surge of larger steelhead is sometimes considered to be a run or race separate from the earlier arriving "half-pounders".

A spring-run of large steelhead migrates into the Klamath River in May and June. These fish hold over in deep, cold, pools and spawn the following winter. Distinct populations of spring steelhead occur in the New River, a large tributary of the Trinity River, and the Salmon River, a tributary of the Klamath River. This run, considered collectively with the two portions of the fall-run, is often referred to as summer-run steelhead.

Winter steelhead commence spawning migrations into tributaries of the lower Klamath River from December through February. In the middle Klamath segment, the migration continues to mid-May. In the larger tributaries of the upper Klamath River, (e.g., Scott River), and in the Salmon River drainage, migration begins in September and continues through November, while fish enter the small streams usually from December through April. In tributaries of the Trinity River spawning migration begins in December and continues through April.

Steelhead spawning in the tributaries of the lower and middle Klamath begins in January and continues through April and mid-May, respectively. In tributaries of the upper Klamath River, including the Salmon and Scott Rivers, spawning begins in mid-December and contines through April. In tributaries of the Trinity River system spawning occurs primarily from February through April.

Egg incubation in tributaries of the lower and middle Klamath River begins immediately after spawning and continues through June. However, in tributaries of the upper Klamath, including the Scott and Salmon Rivers, eggs incubate from mid-December through mid-June. In the smaller streams of the lower

Trinity River incubation begins in February and continues through mid-June, while in the upper Trinity incubation continues to the end of June. With few exceptions, emergence of alevins begins in March and continues through June. However, in tributaries of the middle Klamath and upper Trinity Rivers emergence continues through mid-July.

Juvenile steelhead usually rear for two years in freshwater before out-migration, although some fish emigrate after spending one or three years in nursery streams (USFS 1972). Out-migration of smolts appears to be size-dependent, occurring after most fish reach approximately 16 cm (USFS 1972). Rearing steelhead may be found in tributaries of the Klamath River system during all months of the year. Out-migration of winter steelhead occurs from March through June in the Klamath River system, although smolts from every run may be found emigrating during all months of the year.

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TABLE 1

LIFE STAGE PERIODICITY CHART FOR FALL CHINOOK SALMON IN TRIBUTARIES OF THE LOWER KLAMATH RIVER (mouth to Trinity River confluence)

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration										X	X	X
Spawning	X										15th	X
Egg Incubation	X	X	X								15th	X
Emergence		X	X	15th								
Out Migration		X	X	X	X	15th						

TABLE 2

LIFE STAGE PERIODICITY CHART FOR FALL CHINOOK SALMON IN TRIBUTARIES OF THE MIDDLE KLAMATH RIVER (Trinity River confluence upstream to the Scott River confluence)

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration	X									X	X	X
Spawning	X									X	X	X
Egg Incubation	X	X	X							X	X	X
Emergence	X	X	X									X
Out Migration		X	X	X	X	15th						

TABLE 3

LIFE STAGE PERIODICITY CHART FOR FALL CHINOOK SALMON IN TRIBUTARIES OF THE UPPER KLAMATH RIVER (Scott River confluence to Iron Gate Dam)

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration									X(L)	X(L)	X	X
Spawning									X(L)	X(L)	X	X
Egg Incubation	X	X							X(L)	X(L)	X	X
Emergence	X	X									X(L)	X(L)
Out Migration		X	X	X	X	15th						

(L) = large tributary streams (e.g., Scott River)

TABLE 4

LIFE STAGE PERIODICITY CHART FOR FALL CHINOOK SALMON IN TRIBUTARIES OF THE TRINITY RIVER

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration									X(L)	X(L)	X	X
Spawning										X(L)	X	X
Egg Incubation	X	X								X(L)	X	X
Emergence	X	X										X(L)
Out Migration		X	X	X	X	15th						

(L) = large tributary streams

TABLE 5

LIFE STAGE PERIODICITY CHART FOR SPRING CHINOOK SALMON IN TRIBUTARIES OF THE KLAMATH RIVER

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration				X	X	X						
Spawning										X	X	
Egg Incubation	X									X	X	X
Emergence	X	X										X
Out Migration		X	X	X	X	15th						
Holding						X	X	X	X			

TABLE 6

LIFE STAGE PERIODICITY CHART FOR SPRING CHINOOK SALMON IN TRIBUTARIES OF THE TRINITY RIVER

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration				X	X	X	X	X	X	X		
Spawning									X	X	X	
Egg Incubation	X								X	X	X	X
Emergence	X	X									X	X
Out Migration		X	X	X	X	15th						
Holding						X	X	X	X			

TABLE 7

LIFE STAGE PERIODICITY CHART FOR COHO SALMON IN TRIBUTARIES OF THE KLAMATH AND TRINITY RIVERS

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration										X	X	X
Spawning	X	?									X	X
Egg Incubation	X	X	X								X	X
Emergence		X	X	X	15th							
Out Migration		X	X	X	X	15th						
Rearing	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 8

LIFE STAGE PERIODICITY CHART FOR WINTER STEELHEAD IN TRIBUTARIES OF THE LOWER KLAMATH RIVER (mouth upstream to confluence of Trinity River)

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration	X	X										X
Spawning	X	X	X	X								
Egg Incubation	X	X	X	X	X	15th						
Emergence			X	X	X	X						
Out Migration			X	X	X	X						
Rearing	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 9

LIFE STAGE PERIODICITY CHART FOR WINTER STEELHEAD IN TRIBUTARIES OF THE MIDDLE KLAMATH RIVER (Trinity River confluence upstream to the Scott River)

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration	X	X	X	X	15th							X
Spawning	X	X	X	X	15th							
Egg Incubation	X	X	X	X	X	X						
Emergence			X	X	X	X	15th					
Out Migration			X	X	X	X						
Rearing	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 10

LIFE STAGE PERIODICITY CHART FOR WINTER STEELHEAD IN TRIBUTARIES OF THE UPPER KLAMATH RIVER (Scott River confluence to Iron Gate Dam)

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration	X	X	X	X					X(L)	X(L)	X(L)	X
Spawning	X	X	X	X								15th
Egg Incubation	X	X	X	X	X	15th						15th
Emergence			X	X	X	X						
Out Migration			X	X	X	X						
Rearing	X	X	X	X	X	X						

(L) = larger tributary streams

TABLE 11

LIFE STAGE PERIODICITY CHART FOR WINTER STEELHEAD IN THE SALMON RIVER DRAINAGE

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration	X	X	X	X					X(L)	X(L)	X(L)	X
Spawning	X	X	X	X								15th
Egg Incubation	X	X	X	X	X	15th						15th
Emergence			X	X	X	X						
Out Migration			X	X	X	X						
Rearing	X	X	X	X	X	X	X	X	X	X	X	X

(L) = larger tributary streams

TABLE 12

LIFE STAGE PERIODICITY CHART FOR WINTER STEELHEAD IN THE SCOTT RIVER DRAINAGE

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration	X	X	X	X							X	X
Spawning	X	X	X	X								15th
Egg Incubation	X	X	X	X	X	15th						15th
Emergence			X	X	X	X						
Out Migration			X	X	X	X						
Rearing	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 13

LIFE STAGE PERIODICITY CHART FOR WINTER STEELHEAD IN TRIBUTARIES OF THE LOWER TRINITY RIVER (mouth to confluence of the North Fork Trinity)

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration	X	X	X	X								X
Spawning		X	X	X								
Egg Incubation		X	X	X	X	15th						
Emergence			X	X	X	X						
Out Migration			X	X	X	X						
Rearing	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 14

LIFE STAGE PERIODICITY CHART FOR WINTER STEELHEAD IN TRIBUTARIES OF THE UPPER TRINITY RIVER (North Fork Trinity confluence to Lewiston Dam)

EVENT	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Spawning Migration	X	X	X	X								X
Spawning		X	X	X								
Egg Incubation		X	X	X	X	X						
Emergence			X	X	X	X	15th					
Out Migration			X	X	X	X						
Rearing	X	X	X	X	X	X	X	X	X	X	X	X

APPENDIX A

Participants in the Anadromous Salmonid Life Stage Periodicity Discussions Held December 9, 1982, Redding, California

Name	Agency
Jerry Barnes	Six Rivers National Forest, Eureka, CA
Dr. Roger Barnhart	U.S. Fish and Wildlife Service, Cooperative Fisheries Unit, Arcata, CA
Bill Bemis	Klamath National Forest, Happy Camp District
Phillip L. Dunn	Oscar Larson and Associates, Eureka, CA
John M. Hayes	California Department of Fish and Game (CDFG) Region I, Redding, CA
Bill Heubach	CDFG, Anadromous Fishery Branch, Arcata, CA
Dave Hoopaugh	CDFG, Region I, Redding, CA

APPENDIX A (continued

Name	Agency
Richard Hunn	Ott Water Engineers, Redding, CA
Dick Irizarry	Shasta-Trinity National Forest, Redding, CA
Dennis P. Lee	CDFG, Anadromous Fishery Branch, Sacramento, CA
George R. Leidy	U.S. Fish and Wildlife Service, Division of Ecological Services, Sacramento, CA
Dave McLeod	CDFG, Region I, Eureka, CA
Ed Miller	CDFG, Region I, Lewiston, CA
Thomas R. Payne	Thomas R. Payne and Associates, Arcata, CA
Douglas B. Parkinson	Douglas B. Parkinson and Associates, Bayside, CA
Ivan Paulsen	CDFG, Anadromous Fishery Branch, Yreka, CA

APPENDIX A (continued)

Name	Agency
Dave Rogers	**CDFG, Region I, Yreka, CA**
Jim Schuler	CDFG, Environmental Services Branch, Sacramento, CA
John L. Thomas	CDFG, Region I, Weaverville, CA
Phil Warner	CDFG, Region I, Redding, CA
Paul Wertz	CDFG, Region I, Redding, CA
Dick Wood	CDFG, Region I, Eureka, CA