95-FP-08 & 96-FP-18

Project Title: Mainstem Klamath River Fall Chinook Spawning Redd Survey

U. S. Fish and Wildlife Service, Coastal California Fish and Wildlife Office

Abstract

With the decreasing runs of natural fall chinook salmon, *Oncorhynchus tshawytscha*, in the Klamath River basin, concerns were raised regarding the accuracy and significance of the mainstem Klamath River fall chinook spawner estimates. The U. S. Fish and Wildlife Service, Coastal California Fish and Wildlife Office (CCFWO) was funded through the Klamath River Fish and Wildlife Restoration Act (P. L. 99-552) in the Fall of 1993-1996 to address this concern. The 1995 and 1996 survey season marked the third and fouth year that the CCFWO conducted investigations on the upper mainstem Klamath River to derive a reasonable estimate of natural fall chinook spawners.

A total of 339 redds were observed in the 1993 survey. In 1994 and 1995, redd counts increased to a total of 1,702 and 3,240 respectively. During the 1994 and 1995 spawning seasons, there was evidence that unspawned surplus adult fall chinook salmon released from Iron Gate Hatchery (IGH) successfully spawned in the Klamath River. One hatchery fin clipped adult was observed spawning 30 miles downstream of the hatchery. In 1996, 1,372 redds were observed which was a decrease of 43% from the previous year. There was complete retention of hatchery origin adults by IGH in 1996, although, the distribution of redds remained the same as previous years. With the new hatchery polish of excess return retention, mainstem escapement can now be considered a reasonable estimate of natural spawning adult chinook salmon.

Redd substrate composition estimates remained consistent with previous spawning survey data. Based upon 210 redd measurements from 1995-1996, the average redd size in the mainstem of the Klamath River was 9.6 m2. The average pit depth, mound depth, and adjacent depth for 1995-1996 was similar to previous survey results. Redds were most common along the wetted channel margins with numerous redds observed in side channels with suitable gravel and water velocities. Unlike 1993 and 1994 some redds were observed by 1995 and 1996 survey crews in mid-channel areas.

Recreational suction dredge mining was present throughout the survey from the confluence of Scott River downstream to the confluence of Indian Creek, Although only two redds were observed on recent dredge tailings. Under the existing mining regulations, adverse impacts on redds could occur below the Scott River without protection of spawning areas.

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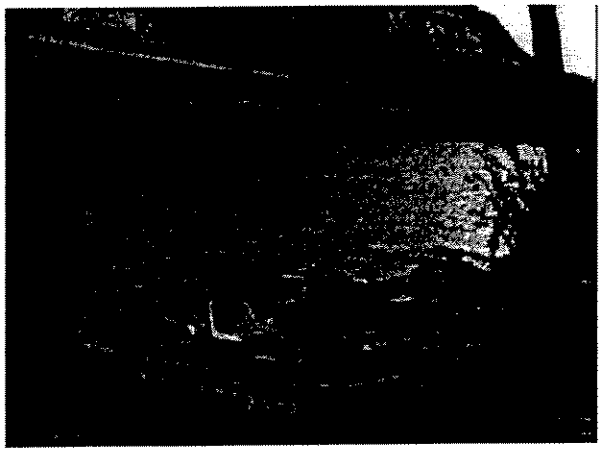
*Fiscal Year 1995 and 1996*

**U.S. Fish & Wildlife Service**
**Coastal California Fish & Wildlife Office**
**Arcata, CA**



October, 1997
Funded by: Klamath River Fish & Wildlife Restoration Act (P.L. 99-552)

# Mainstem Klamath River
# Fall Chinook
# Spawning Redd Survey
***Fiscal Year 1995 and 1996***

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Prepared by Mark Catalano, Dennis Therry, Richard Quihillalt, and Thomas A. Shaw

Funded by: Klamath River Fish & Wildlife Restoration Act (P.L. 99-552)
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## DISCLAIMER

Mention of trade names or commercial products in this report does not constitute endorsement by the U.S. Fish and Wildlife Service.

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## ABSTRACT

With the decreasing runs of natural fall chinook salmon, *Oncorhynchus tshawytscha*, in the Klamath River basin, concerns were raised regarding the accuracy and significance of the mainstem Klamath River fall chinook spawner estimates. The U.S. Fish and Wildlife Service, Coastal California Fish and Wildlife Office (CCFWO) was funded through the Klamath River Fish and Wildlife Restoration Act (P. L.99-552) in the Fall of 1993-1996 to address this concern. The 1995 and 1996 survey season marked the third and fourth year that the CCFWO conducted investigations on the upper mainstem Klamath River to derive a reasonable estimate of natural fall chinook spawners.

A total of 339 redds were observed in the 1993 survey. In 1994 and 1995, redd counts increased to a total of 1,702 and 3,240 respectively. During the 1994 and 1995 spawning seasons, there was evidence that unspawned surplus adult fall chinook salmon released from Iron Gate Hatchery (IGH) successfully spawned in the Klamath River. One hatchery fin clipped adult was observed spawning 30 miles downstream of the hatchery. In 1996, 1,372 redds were observed which was a decrease of 43% from the previous year. There was complete retention of hatchery origin adults by IGH in 1996, although, the distribution of redds remained the same as previous years. With the new hatchery policy of excess return retention, mainstem escapement can now be considered a reasonable estimate of natural spawning adult chinook salmon.

Redd substrate composition estimates remained consistent with previous spawning survey data. Based upon 210 redd measurements from 1995-1996, the average redd size in the mainstem of the Klamath River was 9.6 $m^2$. The average pit depth, mound depth, and adjacent depth for 1995-1996 was similar to previous survey results. Redds were most common along the wetted channel margins with numerous redds observed in side channels with suitable gravel and water velocities. Unlike 1993 and 1994 some redds were observed by 1995 and 1996 survey crews in mid-channel areas.

Recreational suction dredge mining was present throughout the survey from the confluence of Scott River downstream to the confluence of Indian Creek, although only two redds were observed on recent dredge tailings. Under the existing mining regulations, adverse impacts on redds could occur below the Scott River without protection of spawning areas.

# INTRODUCTION

The Klamath River Basin drains approximately 14,000 square kilometers ($km^2$) in Oregon and 26,000 $km^2$ in California and has historically supported large runs of chinook salmon and other anadromous fish, which in past years have contributed considerably to subsistence, sport and commercial fisheries in California (Synder 1931). The basin has been altered substantially during the past century. During this period, anadromous salmonid fishery resources have severely declined. Losses, including the quality of instream habitat and population size of salmon, have coincided with expanded logging and fishing operations, construction of roads and dams, water export, mining, and other developments (U.S. Dept. of the Interior 1985). In response to problems associated with anadramous fishery resources of the basin, Congress enacted P.L. 99-552, the Klamath River Fish and Wildlife Restoration Act of 1986. This legislation authorized the Secretary of the Interior to restore anadromous salmonid stocks in the Klamath Basin to levels relative to historic populations.

The estimated numbers of fall chinook salmon spawning in the upper mainstem Klamath River (upstream from the Trinity River confluence) during 1978-1992 has varied from a low of 366 adults in 1992 to a high of 4,190 adults in 1979 (Hubbell, 1993). In earlier years, spawning estimates were derived by limited surveys based on aerial redd counts and ground surveys. In latter years, this estimate was based on the number of spawners in selected Klamath River tributaries. Historic surveys were focused above Trees of Heaven campground at river kilometer (rkm) 276.0. Interviews conducted with local fishing guides, who have fished the Klamath River for decades, indicated that there was significant spawning in the mainstem Klamath River from Iron Gate Dam (rkm 306.1) downstream to the confluence of Indian Creek (rkm 171.8). Limited spawning was also noted below Dillon Creek (rkm 135.7). With the decreasing runs of natural fall chinook salmon in the Klamath River basin, concerns were raised regarding the accuracy and significance of the mainstem Klamath River fall chinook spawner estimates. CCFWO was funded through the Klamath River Fish & Wildlife Restoration Act in the fall of 1993 through 1996 to address this concern. Surveys utilizing inflatable catarafts were considered the most effective method for observing spawning redds of fall chinook salmon in the mainstem of the Klamath River (Iron Gate Dam to the confluence of Indian Creek). These surveys were conducted from mid-October through late November. The 1993 surveys indicated that spawning did occur throughout the mainstem from Iron Gate Dam to the confluence of Indian Creek with limited spawning activity occurring downstream. In the 1993 survey, only 26 % of the observed redds were located above the Shasta River confluence which was once believed to support the majority of mainstem fall chinook spawners. The 1994-96 survey results indicated that 50%, 55%, and 52%, respectively, of the redds observed were above the Shasta River confluence.

Due to high spawning activity above Indian Creek, the U.S. Forest Service (Klamath National Forest, Happy Camp Ranger District) assisted CCFWO in 1995 by conducting surveys from the confluence of Indian Creek to the USFS Green Riffle river access. In 1996, the USFS (Klamath National Forest, Happy Camp, Ranger District) surveyed redds from Indian Creek to Independence Creek and the USFS (Klamath National Forest, Orleans, Ranger District) surveyed

from the Orleans bridge to Big Bar river access.

# MATERIALS AND METHODS

## Rafting Equipment

Two 3.8 m (15ft.) long inflatable catarafts (as shown in the photograph on the cover page) were used for direct observation of fall chinook salmon redds, carcasses, and spawning gravel location. These rafts were noted for use in white water rescue, due to their ability to maneuver and stability in fast water. The rafts were stacked on a raft trailer and deployed at numerous access points along the study area. Each raft was equipped with a rowing frame and modified by CCFWO with an observation platform and anchoring system. Two personnel operated each raft (rower and observer). Each cataraft crew covered the same reaches each week throughout the survey period to remain familiar with the survey reach and redd locations. Safety equipment included; life jackets, throw ropes, dry and wet suits, helmets, tubing, carabiners, first aid kits, raft repair kits, 15.2 m (50 ft.) of braided nylon line and an extra oar. Each raft was equipped with an anchor pulley system including 15.2 m (50 ft.) of anchor line and a 13.5 kg (30 lb.) pound pyramid anchor.

## Survey Equipment

Measuring staffs were used to measure spawning redd pit depth (as shown in the photograph on the cover page), mound depth, length, width and adjacent depth outside the mound. The measuring staffs also help the observers to balance while standing on the observation deck. Gaffs were used to reach into the water and bring carcasses to the shore for identification and sampling purposes. Plastic survey flagging tape was used to flag individual redds and redd sites along the river bank in each reach. Other equipment used in the spawning surveys include flow meters, measuring tape, range finders, hunting knives, scale envelopes, topographical maps, data forms, write in the rain and plastic paper, clipboards, and permanent markers. Polarized sunglasses and baseball style caps were used to cut down glare from the sun and improve visibility into the water. Neoprene waders were used to stay dry and to keep warm. Felt bottom boots were used for wading purposes.

## Redd Data

The date, number of redds, stream location of redds, and redd site number were recorded on each flag. A different color survey flag was used each week to ensure that redds were not double counted. Survey flags were attached to trees, or other permanent fixtures adjacent to redd sites. Redd sites were also recorded on topographic maps and on data forms. Data entered into the data forms included habitat unit type, location in unit (left bank, mid-channel, right bank, side channel), flagging location, presence of live fish and age of redd (fresh/old). Only completed redds, or redds with fish on them were included in the daily counts, test redds were omitted. Redds included in the survey exhibited a freshly scoured oval pattern with a definite mound downstream and a pit, or depression, upstream from the mound. Numerous redds contained more than one nest (as shown in the photograph on the cover page) and were counted

accordingly. New redds and lost flags were recognized by corresponding flagging with field notes and topographic maps.

**Redd Substrate Data**

A random selection of redds were measured for length, mean width, depth of pit, depth of mound, adjacent depth and an estimate of substrate composition. Substrate composition was divided into five particle categories that included large cobble (15-30 cm.), small cobble (8 to 15 cm.), large gravel (3.5 to 8 cm.), small gravel (0.5-3.5 cm.), and sand/silt/clay (SSC) particles, (<0.5 cm.). When taking redd measurements, caution was used to minimize substrate disturbance in and around the redd site.

**Carcass Data**

Due to the high concentration of carcasses from Iron Gate Dam to the confluence of Shasta River, carcass surveys were limited to downstream of the confluence of the Shasta River. Data collected on measurable carcasses included fork length (cm), sex, scales, presence or absence of adipose fin, location, and spawning success. Spawning success was determined by the amount of egg or sperm found in the carcass upon examination. Hunting knives were used to cut sampled carcasses in half to avoid repeat sampling. A scale sample was taken from each carcass sampled, if possible, and placed in a scale card envelope. Upon return to the office scales were cleaned and mounted between microscope slides. Age estimates were made using visual interpretation of annuli by three readers. Where disagreement of age estimates existed, scales were read again and age determined by joint agreement.

**Survey Reach Locations**

The mainstem Klamath River from Iron Gate Dam to the confluence of Indian Creek was divided into six reaches (Figure 1). These reaches were surveyed weekly unless adverse weather limited visibility of the water to less than 1 meter deep.

Reach 1: Iron Gate Dam river access (rkm 306.1) to Ash Creek river access (rkm 281.6).

This section is 24.5 rkm (15.2 miles) in length. Due to time constraints this reach was split in 1995 and 1996 surveys into two days. Half of day one (Monday) consisted of traveling from Arcata, California to the access point at the junction of Interstate 5 (I-5) and Highway 96 where a short section of Reach 1 from the I-5 Rest Area river access to the Ash Creek river access was surveyed late in the afternoon. On day 2 the Reach 1 survey was resumed from the Iron Gate Dam river access to the Highway I-5 Rest Area access. One class III rapid was encountered in this reach.

The Iron Gate Dam, PacifiCorp river access is located across the river from Iron Gate State

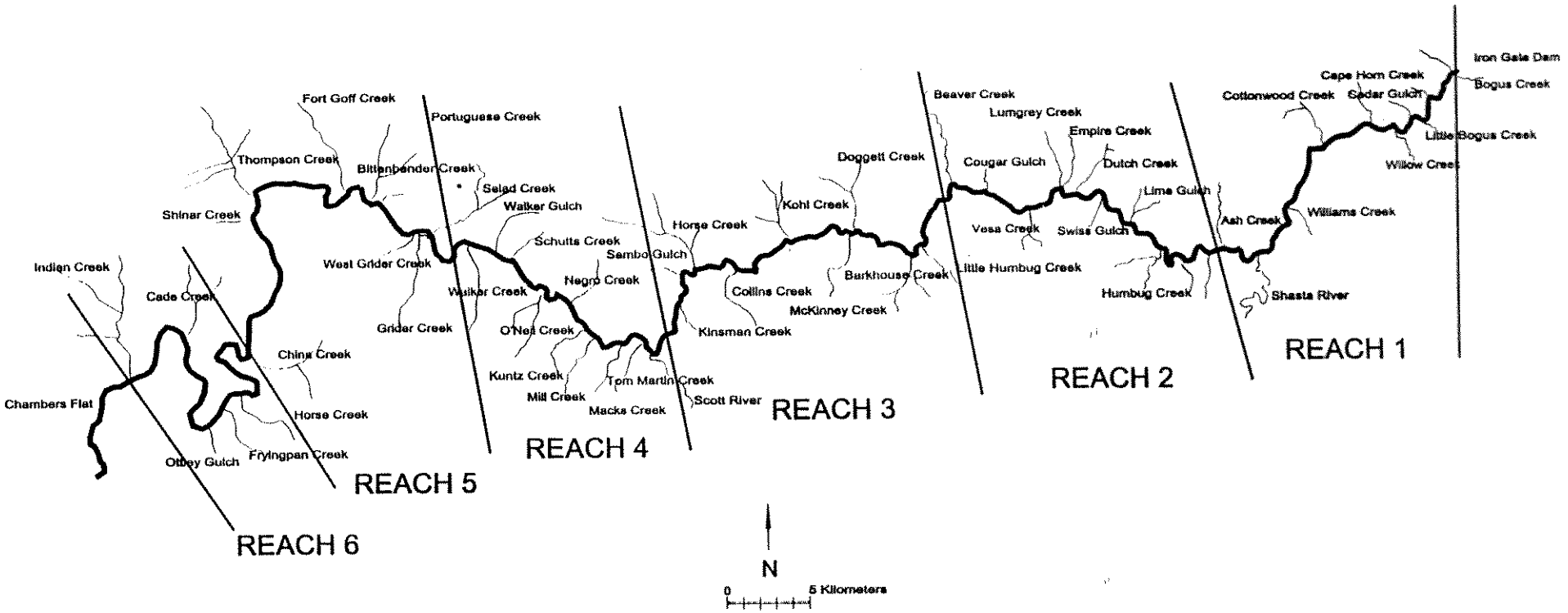


Figure 1. Klamath River chinook spawning survey project location including individual study reaches

Fish Hatchery. The I-5 Rest Area access is located along the left bank (looking downstream) of the Klamath River just upstream of the rest area. The Ash Creek access is located along the left bank of the river which was accessed by crossing the Ash Creek Bridge off Highway 96, turning to the right and driving downstream about 1 mile. A high percentage of total redds were observed in Reach 1. For this reason two cataraft crews survey this area. One crew surveyed from the left bank to mid-channel area while the second crew surveyed from the right bank to mid-channel area. This reach was completed in 8 to 10 hours.

Reach 2: Ash Creek river access (rkm 281.6) to Beaver Creek Riffle river access (rkm 257.1)

This section is 24.5 rkm (15.2 miles). The Beaver Creek Riffle river access is located along the right bank on a large gravel bar downstream of Beaver Creek bridge, just off Highway 96. One crew surveyed this reach on day 3 and required approximately 7 hours to complete. Two class III and one class IV rapids were encountered in this reach.

Reach 3: Beaver Creek river access (rkm 257.1 ) to Blue Heron river access (rkm 231.8)

This section is 25.3 rkm (15.7 miles). The Blue Heron river access is approximately two kilometers upstream of the Scott River. This reach was surveyed by one crew on day 3 in approximately eight hours.

Reach 4: Blue Heron river access (rkm 212.7) to Seiad Bar river access (rkm 189.8)

This section is 19.1 rkm (11.6 miles). The Seiad Bar river access is located along the right bank of the Klamath River. It was reached by a road to the left of the California Transportation Maintenance building at Seiad Valley. The road is approximately a mile long and a four wheel drive vehicle is recommended. This reach was surveyed on day four by one cataraft crew in approximately 8 hours. Three class III and one class IV rapids were encountered.

Reach 5: Seiad Bar river access (rkm 212.7) to China Point river access (rkm 189.8)

This reach is 22.9 rkm (14.2 miles). China Point river access is located along the right bank of the Klamath River at the USFS river access just off Highway 96. Four wheel drive venicles should be used during adverse weather conditions. One cataraft crew surveyed this reach on day four in approximately seven hours. Two class IV rapids were encountered.

Reach 6: China Point river access (rkm 189.8) to Indian Creek confluence (rkm 171)

This reach is 18.7 rkm (11.6 miles). Due to the high concentration of redds, this reach was split at the Gordon Ferry access point. China Point river access to Gordon's Ferry river access is 7.2 river kilometers (4.5 miles). Gordon's Ferry river access to Indian Creek confluence is 11.5 river kilometers (7.1 miles). The Gordon Ferry river access is located along the right bank of the Klamath River just off Highway 96. The confluence of Indian Creek is located at the Indian

Creek river access in Happy Camp, CA. This reach is covered by two crews on day five in approximately 4 hours.

**USFS Survey locations Below Indian Creek**

In 1995 the USFS Happy Camp Ranger District, surveyed from the confluence of Indian Creek (rkm 171.1) to Green Riffle (rkm 112.5).

In 1996, the USFS Happy Camp Ranger District, surveyed from Indian Creek to Independence Creek. The USFS Orleans Ranger District also surveyed from the Orleans bridge to Big Bar river access.

# RESULTS AND DISCUSSION

In 1995, a total of 3,236 redds (Table 1) were observed from Iron Gate Dam to the confluence of Indian Creek. The redd count in 1995 was a substantial increase from the 1,656 redds observed in 1994 and the 330 redds observed in 1993 (Table 1). The USFS, Happy Camp Ranger District observed an additional 60 redds between Indian Creek and the Green Riffle river access.

During 1996, a total of 1,372 redds were observed (Table 1). The USFS Happy Camp and Orleans Ranger Districts observed an additional 23 redds below the confluence of Indian Creek to Big Bar river access.

**Redd Distribution:**

Based on field maps and notes provided by cataraft crews, map locations of redds between IGH and the confluence of Indian Creek are shown in Figures 2 through 5 for 1995 and 1996 surveys.

**Survey Results of Reach 1 through 6:**

Redd surveys were conducted weekly from October 16 through December 1, in 1995. Due to the governmental furlough, surveys were interrupted from November 13-24. In 1996, redds surveys were conducted from October 21 through November 15.

The 1996 survey was terminated after four weeks of survey effort due to severe weather and mainstem flow conditions that began late in November and extended into late December which prevented spawning crews from conducting a fifth and final week of reliable surveys. Numbers of redds observered during week 4 (Oct. 11-15) of the 1996 survey declined to very low numbers through all the reaches. Limited redds were probably missed when survey crews were prevented from conducting a final survey in week number 5..

Each of the six reaches surveyed in 1995 and 1996 are described below and compares weekly redd counts with the 1993-1994 results.

Reach 1: Iron Gate Dam to Ash Creek river access (Table 1, Figure 2).

A total of 704 redds (51% of the 1,372 redds observed were counted in this reach in 1996 compared with 1,799 (55% of the 3,236 redds observed) in 1995. 831 redds (48% of the 1,656 redds observed) in 1994, and 87 redds (26% of the 330 redds observed) in 1993 were counted in this reach. As observed in 1993 and 1994 , peak spawning occurred near late October and early November. Both 1996 and 1995 surveys reported very few redds from the Highway 236 bridge to the confluence of Ash Creek.

During the 1994 and 1995, surveys it was assumed that many of the adults in this reach were of IGH origin. In 1996, IGH retained their excess returns. The observed redd distribution was similar to previous years when IGH did not retain excess returns. This information suggests that

| REACH | 1993 | | | | | 1994 | | | | | | | 1995 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Week 1 Oct 25-29 | Week 2 Nov 01-11 | Week 3 Nov 08-12 | Week 4 Nov 15-18 | 1993 TOTAL | Week 1 Oct 17-21 | Week 2 Oct 24-28 | Week 3 Oct 31-Nov 04 | | Week 4 Nov 07-11 | Week5 Nov 14-18 | 1994 TOTAL | Week 1 Oct 16-20 | Week 2 Oct 23-27 | Week 3 Oct 30-Nov 03 | Week 4 Nov 06-10 | Week 7 Nov 27-Dec 01 | 1995 TOTAL |
| Reach 1 : Iron Gate Dam to Ash Creek River Access | 15 | 67 | 5 | 0 | 87 | 89 | 278 | 375 | | 86 | 3 | 831 | 138 | 598 | 727 | 277 | 39 | 1779 |
| Reach 2 : Ash Creek River Access to Beaver Creek Riffle | 13 | 24 | 1 | 0 | 38 | 28 | 59 | 20 | | n.s. | 2 | 109 | 12 | 82 | 58 | 26 | 9 | 187 |
| Reach 3 : Beaver Creek Riffle to Blue Heron River Access | 30 | 4 | 18 | 4 | 56 | 48 | 77 | 46 | | n.s. | 7 | 178 | 70 | 199 | 78 | 49 | 14 | 410 |
| Reach 4 : Blue Heron River Access to Seiad Bar | 18 | 1 | 7 | 5 | 31 | n.s. | 113 | 42 | | n.s. | 4 | 159 | 26 | 94 | 35 | 13 | 4 | 172 |
| Reach 5: Seiad Bar to China Point River Access | 16 | 15 | 0 | 0 | 31 | n.s. | 98 | 16 | | n.s. | 5 | 119 | 30 | 91 | 57 | 25 | 12 | 215 |
| Reach 6 : China Point River Access to Indian Creek | 81 | 5 | 1 | 0 | 87 | 98 | 124 | 33 | | n.s. | 5 | 260 | 139 | 169 | 112 | 50 | 3 | 473 |
| TOTAL | 173 | 116 | 32 | 9 | 330 | 263 | 749 | 532 | | 86 | 26 | 1656 | 415 | 1233 | 1067 | 440 | 81 | 3236 |

| REACH | 1996 | | | | |
|---|---|---|---|---|---|
| | Week 1 Oct 21-25 | Week 2 Oct 28 - Nov 1 | Week 3 Nov 04-08 | Week 4 Nov 11-15 | 1996 TOTAL |
| Reach 1 : Iron Gate Dam to Ash Creek River Access | 290 | 291 | 83 | 40 | 704 |
| Reach 2 : Ash Creek River Access to Beaver Creek Riffle | 31 | 29 | 4 | 0 | 64 |
| Reach 3 : Beaver Creek Riffle to Blue Heron River Access | 96 | 25 | 24 | 6 | 151 |
| Reach 4 : Blue Heron River Access to Seiad Bar | 10 | 22 | 8 | 0 | 40 |
| Reach 5: Seiad Bar to China Point River Access | 118 | 42 | 33 | 7 | 200 |
| Reach 6 : China Point River Access to Indian Creek | 39 | 92 | 59 | 23 | 213 |
| TOTAL | 584 | 501 | 211 | 76 | 1372 |

Table 1. Mainstem Klamath River redd counts 1993-1996.

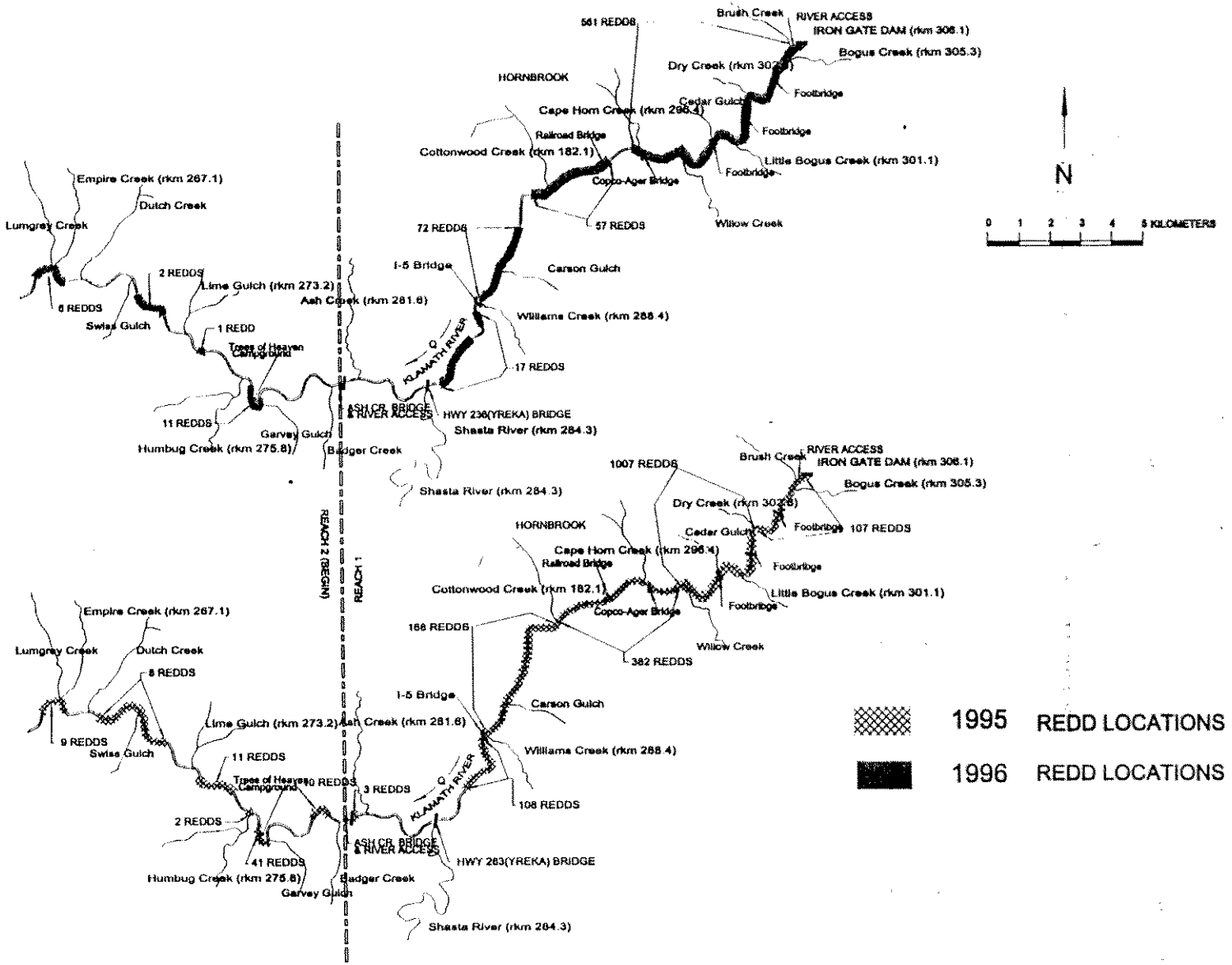


Figure 2. Redd distribution map for 1995-1996 mainstem Klamath River, Iron Gate Hatchery to Lumgrey Creek.

these fish may be of natural origin.

Reach 2: Ash Creek river access to Beaver Creek Riffle river access (Table 1, Figures 2 and 3).

A total of 64 redds (4.6% of 1,372 redds observed) were counted in this reach during the 1996 survey and 187 redds (6% of 3,236) were counted in 1995. 109 redds (6% of 1,656 redds observed) in 1994 and 38 redds (11% of 330 redds observed) in 1993 were counted in this reach. Redds exhibited a similar scattered pattern of distribution and location for 1995 and 1996 surveys but with lower redd numbers in 1996. Redd numbers were particulary low between Cougar Gulch and Beaver Creek Riffle access and downstream of Trees of Heaven campground.

Reach 3: Beaver Creek Riffle river access to Blue Heron river access (Table 1, Figure 3).

A total of 151 redds (11% of 1,372 redds observedred) were counted in this reach in 1996 compared with 410 redds (13% of 3,236 redds observed) in 1995. 178 redds ( 11% of 1,656 redds observed) were counted in this reach in 1994 compared to 56 redds (17% of 330 redds observed) in 1993. Redds were well distributed in this reach, particularly along channel margins and pool tail crests (top of riffles). 1995 and 1996 data show very few redds between the Highway 96 bridge and Horse Creek.

Reach 4: Blue Heron River access to Seiad Bar river access (Table 1, Figures 3 and 4).

A total of 40 redds (3% of 1,372 redds observed) were counted in this reach in 1996 compared to 172 redds (5% of 3,236 redds observed) in 1995. 159 redds (10% of 1,656 redds observed) were counted in this reach in 1994 compared to 31 redds (9% of 330 redds observed) in 1993. Although redd locations for both 1995 and 1996 surveys show scattered concentrations throughout the reach, no redds were observed between Schutts Creek and the Highway 96 bridge in 1996 while 83 redds were counted in the same location in 1995 when more fish were present. During the 1996 survey three lamprey were seen attached to a chinook salmon near Icehouse rapids. The lampreys were approximately 20 cm long. Two lamprey were also seen attached to a chinook salmon near Banyon Tree Riffle.

Reach 5: Seiad Bar access to China Point access (Tabel 1, Figures 4 and 5).

A total of 200 redds (15% of 1,372 redds observed) were counted in this reach in 1996 compared to 215 redds (7% of 3,236 redds observed) in 1995. 119 redds (7% of 1,656 redds observed) were counted in this reach in 1994 compared to 31 redds (9% of 330 redds observed) in 1993. Both 1995 and 1996 surveys show high numbers of redds located in the side channel along lower Seiad Bar and upstream from China Point. During week 5 of the 1995 survey, one coho salmon (*O. kisutch*) redd with attendant fish was observed in the Seiad area.

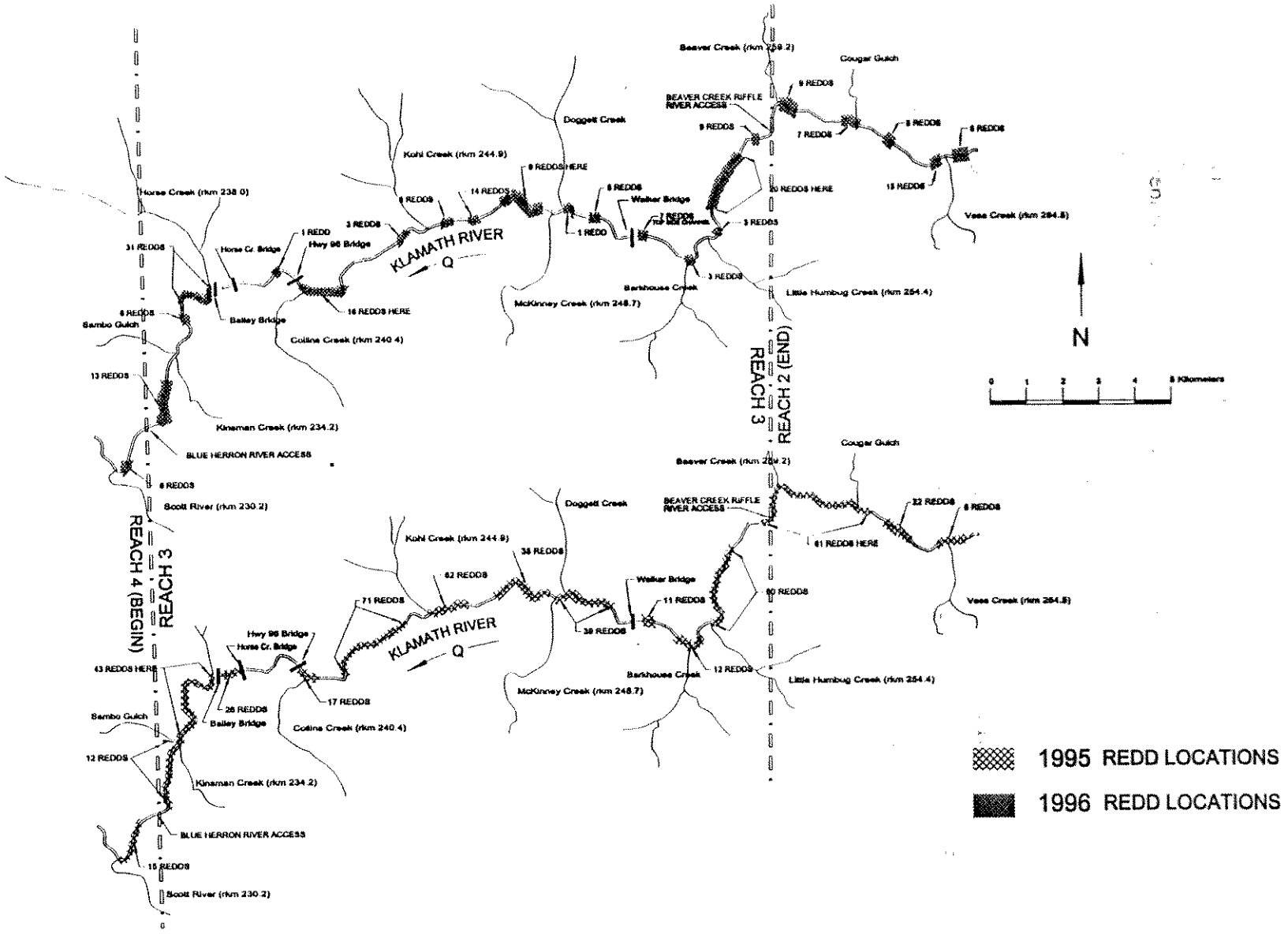


Figure 3. Redd distribution map for 1995-1996, mainstem Klamath River, Vesa Creek to Scott River.

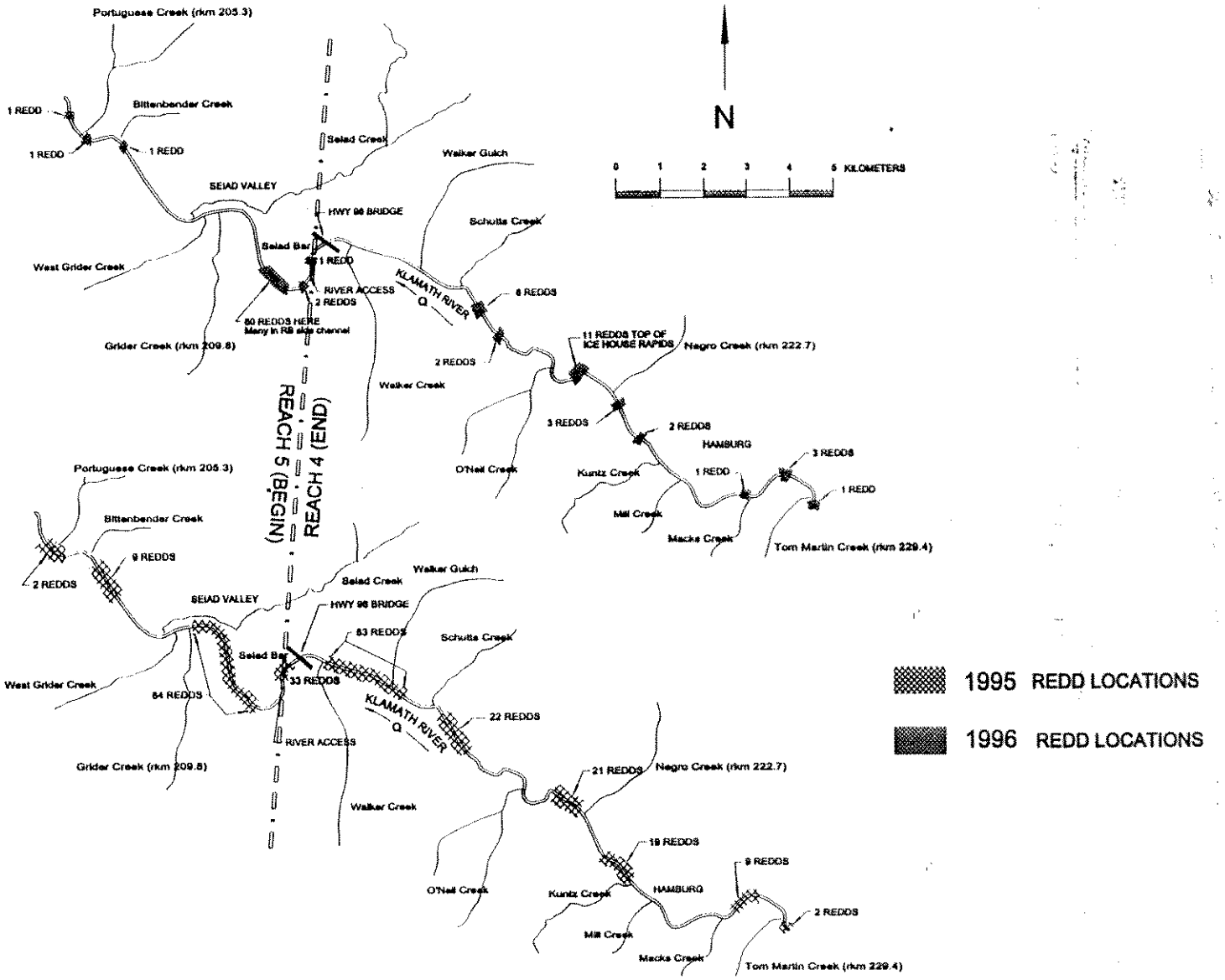


Figure 4. Redd distribution map for 1995-1996, mainstem Klamath River Tom Martin Creek to Portuguese Creek.

Reach 6: China Point river access to Indian Creek river access (Table 1, Figure 5).

A total of 213 redds (15% of 1,372 redds observed) were counted in this reach in 1996 compared to 473 redds (15% of 3,236 redds observed) in 1995. 260 redds (16% of 1,656 redds observed) were counted in this reach in 1994 compared to 87 redds (26% of 300 redds observed) in 1993. Previous survey crews found large concentrations of redds located throughout the Williams Point and China Point areas. However, the distribution of 1995 redds show spawning activity occurring throughout this reach while in 1996 the spawning activity was scattered and isolated, particularly between Ottley Gulch and Indian Creek where redd numbers declined from 187 redds to 50 redds. Suction dredge mining operations were observed in this area in 1996. Four dredges were obsevered duiring the 1996 spawning survey. One of the four dredges observed was operational.

**USFS Surveys Below Indian Creek Confluence :**

In 1995, the USFS, Happy Camp Ranger District observed 61 redds in four days of effort (November 1,2,3 and 6) from the confluence of Indian Creek (rkm 171.1) to Green Riffle (rkm 112.5), (Jon Grunbaum per. Comm.).

In 1996 unpublished information regaurding adult fall chinook salmon redd counts below Indian Creek was received from the USFS, Happy Camp and Orleans Ranger District. The Happy Camp Ranger District observed 19 redds in one survey from Indian Creek river access to Independence Creek river access on November 14. The Orleans Ranger District observed 4 redds in one survey from the Orleans bridge river access to Big Bar river access on November 8 (Table 2).

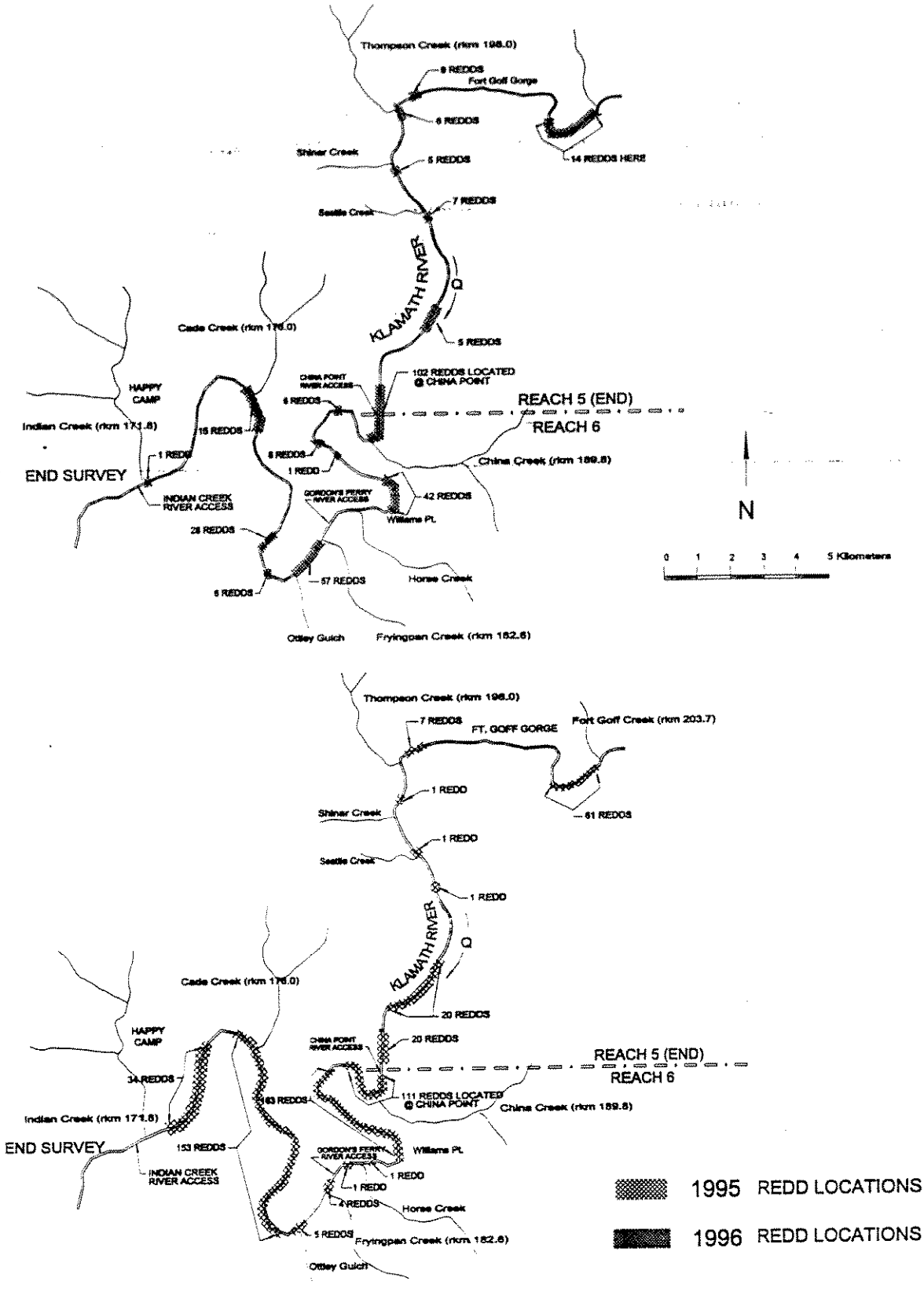


Figure 5. Redd Distribution map for 1995-1996, mainstem Klamath River, Fort Goff to Indian Creek.

Table 2. Mainstem Klamath River spawning redd surveys below Indian Creek confluence.

Arcata US Fish & Wildlife Office surveys.

| 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|
| Presidio Bar to Green Riffle<br>Nov. 15-1 9 redds | ---------- ---------- ----- | ---------- ---------- ----- | ---------- ---------- ----- |

US Forest Service Happy Camp Ranger District surveys.

| 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|
| ---------- ---------- ----- | Indian Cr. to Reynolds Cr.<br>Nov.14-18 40 redds | Indian Creek to Ferry Point<br>Nov. 1st 11 redds | Indian Creek to Independence<br>Nov. 14 Creek 19 redds |
| ---------- ---------- ----- | ---------- ---------- ----- | Ferry Point to Coon Creek<br>Nov. 2nd 15 redds | ---------- ---------- ----- |
| ---------- ---------- ----- | ---------- ---------- ----- | Coon Creek to Presidio Bar<br>Nov. 3rd 19 redds | ---------- ---------- ----- |
| ---------- ---------- ----- | ---------- ---------- ----- | Presidio Bar to Green Riffle<br>Nov.6 16 redds | ---------- ---------- ----- |

US Forest Service Orleans Ranger District surveys.

| 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|
| ---------- ---------- ----- | Orleans to Hopkins Creek<br>Nov. 14-18 6 redds | ---------- ---------- ----- | Orleans Bridge to Big Bar Access<br>Nov. 8 4 redds |

Total (all surveys) 9 redds 46 redds 61 redds 23 redds

## Spawning Redd Counts by Mainstem Tributaries

The mainstem was divided into 10 rkm sections (approximately) to describe frequency of spawning redd occurrence, in percentages, by yearly redd counts between mainstem tributaries (Table 3).

Table 3. Yearly redd frequency, in percent, for each 10 rkm (approx.) section on the mainstem Klamath River, 1993-1996.

| TRIBUTARY REACH (rkm) | RIVER DISTANCE | REACH DISTANCE | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|
| IRON GATE (306.1) -CAPE HORN CK (296.4) | 306 | 10 | 24.2 | 38.9 | 39.1 | 40.9 |
| CAPE HORN CK (296.4)-SHASTA RIVER (284.3) | 296 | 12 | 2.1 | 11.0 | 15.6 | 10.6 |
| SHASTA RIVER (284.3)-HUMBUG CK (275.8) | 284 | 9 | 2.7 | 1.0 | 1.9 | 8.0 |
| HUMBUG CK (275.8)-VESA CK (264.5) | 276 | 11 | 5.5 | 2.1 | 1.1 | 1.1 |
| VESA CK (264.5)-LITTLE HUMBUG CK (254.4) | 265 | 10 | 5.8 | 6.9 | 5.2 | 4.8 |
| LITTLE HUMBUG CK (254.4)-KOHL CK (244.9) | 254 | 10 | 7.9 | 3.5 | 4.9 | 3.3 |
| KOHL CK (244.9)-KINSMAN CK (234.2) | 245 | 11 | 7.9 | 2.7 | 4.9 | 4.2 |
| KINSMAN CK (234.2)-KUNTZ CK (224.4) | 234 | 10 | 2.4 | 4.1 | 1.2 | 2.4 |
| KUNTZ CK (224.4)-WALKER CK (214.4) | 224 | 10 | 6.4 | 5.5 | 3.8 | 1.7 |
| WALKER CK (214.4)-PORTUGUESE CK (205.3) | 214 | 9 | 7.6 | 5.1 | 3.9 | 5.5 |
| PORTUGUESE CK (205.3)-SHINAR CK (199.0) | 205 | 10 | 1.2 | 3.9 | 2.2 | 3.1 |
| SHINAR CK (199.0)-CHINA CK (189.8) | 199 | 9 | 6.7 | 2.2 | 4.4 | 5.9 |
| CHINA CK (189.8)-OTTLEY GULCH (181.1) | 190 | 9 | 12.4 | 7.0 | 6.0 | 10.7 |
| OTTLEY GULCH (181.1)-INDIAN CK (171.3) | 181 | 10 | 7.3 | 5.4 | 5.8 | 4.8 |

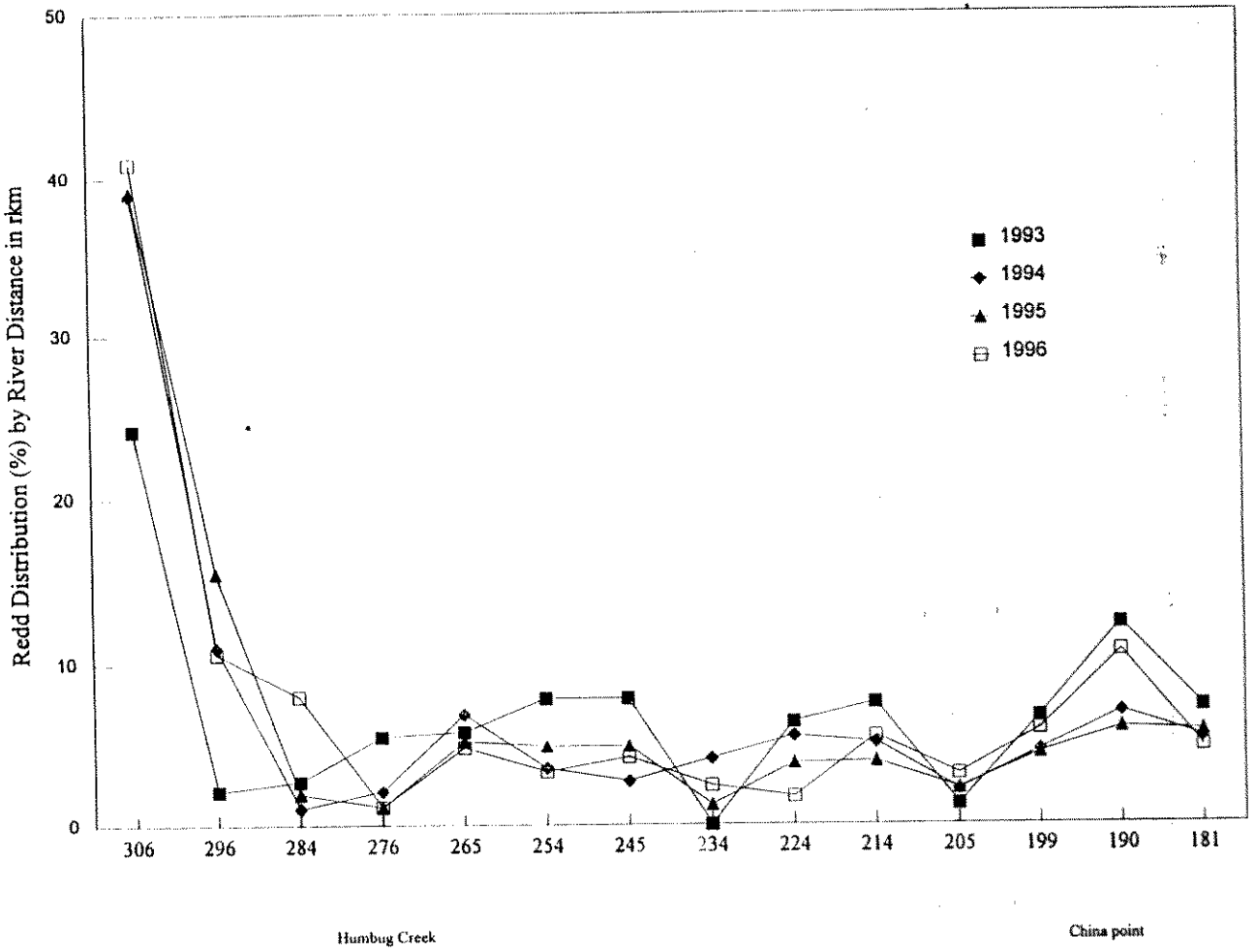


Figure 6. Yearly chinook salmon redd frequency distribution for each (approx.) 10 river kilometer (rkm) section on the mainstem Klamath River from Iron Gate Hatchery (306 rkm) to the confluence of Indian Creek (181 rkm), 1993-1996.

## Redd Measurements

A total of 210 redds were measured during 1995 (n=144) and 1996 (n=66) for length, mean width, area, pit depth, mound depth, adjacent depth and substrate material composition estimates. Measured redds were sampled along mainstem edges, midchannel and side channel locations. This data was used to compare redd data measurements and substrate composition from the 1993-1994 surveys. Average redd measurments for 1993-1996 are shown below (Table 4).

Table 4. AVG. yearly redd measurements, in meters, of chinook salmon redds on the mainstem Klamath River, 1993-1996 (sd=standard deviation, ADJ=adjacent).

| YEAR | | 1994 | 1993 | 1996 |
|---|---|---|---|---|
| AVG. LENGTH | 3.8 | 4.1 | 4.2 | 4.3 |
| *sd* | *1.0* | *1.37* | *1.28* | *1.38* |
| AVG. WIDTH | 1.9 | 2.1 | 2.2 | 2.1 |
| *sd* | *0.66* | *0.66* | *0.66* | *0.79* |
| AVG. AREA | 7.5 | 8.8 | 9.5 | 9.6 |
| *sd* | *4.10* | *5.05* | *4.72* | *6.1* |
| AVG. PIT | 0.76 | 0.71 | 0.67 | 0.68 |
| *sd* | *0.18* | *0.22* | *0.19* | *0.17* |
| AVG. MOUND | 0.52 | 0.44 | 0.41 | 0.44 |
| *sd* | *0.17* | *0.21* | *0.16* | *0.19* |
| AVG. ADJ. | 0.64 | 0.57 | 0.54 | 0.60 |
| *sd* | *0.16* | *0.20* | *0.17* | *0.16* |

**Substrate Composition Characteristics**

Redd substrate material composition was visually estimated and was included with each redd selected for measurements. Although the estimate was subjective to the visual acuity of the recorder, data shows a relative pattern of consistency with previous substrate material estimates. Substrate composition of material in chinook redds was most commonly large gravel and small gravel (Table 5). Large Gravel (3.5 - 8.0 cm.) was the dominant material used in mainstem redd construction representing 40%-43% of redd material during the 1995-1996 spawning surveys. Large cobble (15-30 cm.) and SSC (sand, silt and clay) (<0.5 cm.) substrate materials represented <10% of redd material used in 1995-1996.

Table 5. Mean of substrate materials of chinook salmon redds on the mainstem Klamath River, 1993-1996. Substrate values are percentages of total yearly sample. (SSC=sand, silt and clay)

| SUBSTRATE | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|
| LARGE COBBLE | 4.0% | 9.8% | 8.2% | 4.2% |
| SMALL COBBLE | 18.9% | 24.5% | 24.6% | 19.4% |
| LARGE GRAVEL | 45.0% | 35.0% | 43.1% | 39.9% |
| SMALL GRAVEL | 23.7% | 23.0% | 22.6% | 27.0% |
| SSC | 5.5% | 10.2% | 2.0% | 6.6% |
| SAMPLE SIZE | n=135 | n=144 | n=99 | n=66 |

**Mainstem Water Temperatures**

Mainstem water temperatures in 1996 ranged between 11°C (51.8°F) in week 1 to 13°C (55.4°F) in week 4, well within the preferred temperature range for upstream migration, rearing and incubation of chinook salmon (USFWS 1986). Water temperature measurements were taken weekly upstream of the IGH fish ladder at the start of reach 1.

**Carcass Data**

Mainstem chinook salmon carcasses were collected in 1995 (n=72) and 1996 (n=15) and sampled for scales, length, sex, spawning condition and indication of hook mortalities. All

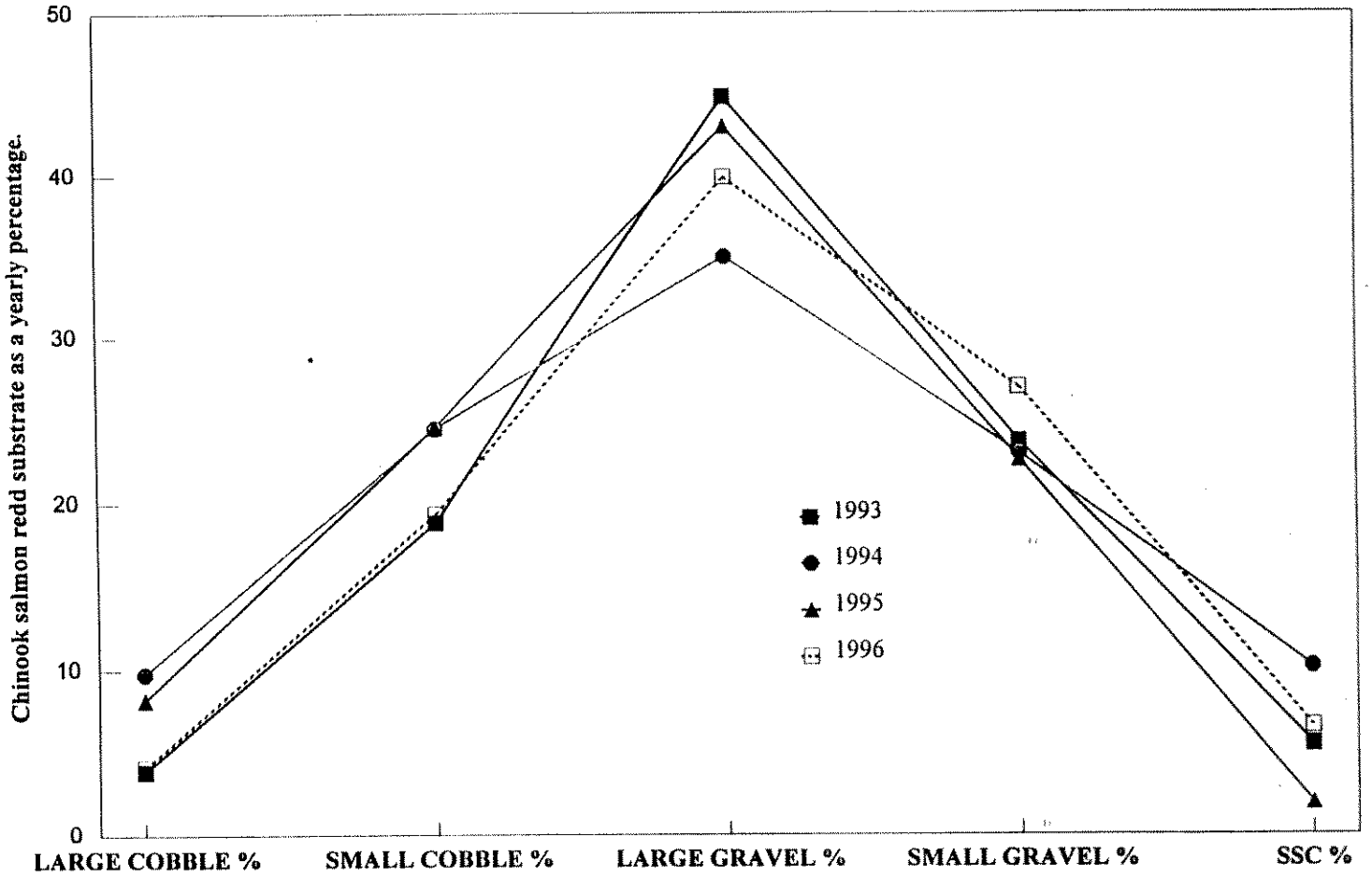


Figure 7. Average frequency distribution by substrate type.

salmon carcasses were collected below the confluence of the Shasta River to Indian Creek. Although no coho salmon were observed in the 1996 survey, two coho salmon carcasses were sampled in the 1995 spawning survey.

Sampled chinook salmon carcasses ranged in length from 44 - 90 cm. in 1995 and from 60 - 90 cm. in 1996. Average carcass length was 74.0 cm. (*sd*=9.4 cm.) in 1995 and 77.4 cm. (*sd* = 8.79 cm). Female carcasses from 1995 (n=40) averaged 70.6 cm. (*sd*=5.3 cm.) and 78.4 cm. (*sd*=9.5 cm.) in 1996 (n=9). Male carcasses in 1995 (n=32) averaged 77.7 cm. (*sd*=11.4 cm.) and 75.8 cm. (*sd*=8.0 cm.) in 1996 (n=6). Age estimates for 1995 show four age classes, age II (8%), age III (76%) age IV (14.7%) and age V (1%). Due to the limited number of 1996 carcasses, age class estimates were not performed.

One adipose fin clipped chinook salmon was sampled in 1995. The code on the recovered coded wire tag read 6-33-35. This decoded to fall chinook, Brood Year 91 Bluff Creek (4 year old). This chinook had successfully spawned approximately 106 kilometers upstream from the confluence of Bluff Creek. Adipose fin clipped fall chinook salmon were not recovered in 1996.

**Adult/Grilse Expansion:**

Based on California Department of Fish and Game estimates, the natural fall chinook spawner escapement on the mainstem of the Klamath river for 1996 was 2,790 adults, and 218 jacks. The estimate for 1995 was 6,472 adults and 768 jacks. Table 6 provides adult/grilse estimates based on male to female ratios and jack percentages observed at upper Klamath River tributary weirs.

Tabel 6. Spawning escapement adult and grilse expansion Klamath River 1993-1996.

| Natural Spawning Area | 1993 | | | 1994 | | | 1995 | | | 1996 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grilse | Adults | Total | Grilse | Adults | Total | Grilse | Adults | Total | Grilse | Adults | Total |
| Salmon River Basin | 456 | 3,077 | 3,533 | 277 | 3,216 | 3,493 | 1,335 | 4,140 | 5,475 | 584 | 4,653 | 5,237 |
| Scott River Basin | 265 | 5,035 | 5,300 | 505 | 2,358 | 2,863 | 3,279 | 11,198 | 14,477 | 629 | 11,387 | 12,016 |
| Shast River Basin | 85 | 1,341 | 1,426 | 1,840 | 3,363 | 5,203 | 695 | 12,816 | 13,511 | 145 | 1,305 | 1,450 |
| Bogus Creek Basin | 431 | 3,285 | 3,716 | 443 | 7,817 | 8,260 | 1,207 | 45,225 | 46,432 | 1,215 | 9,622 | 10,837 |
| Mainstem Klamath River | 31 | 647 | 678 | 625 | 3,249 | 3,874 | 768 | 6,472 | 7,240 | 218 | 2,790 | 3,008 |
| Misc. Klamath tributaries | 92 | 2,470 | 2,562 | 50 | 1,202 | 1,252 | 744 | 3,654 | 4,398 | 581 | 5,840 | 6,385 |
| Total Natural Spawners | 1,360 | 15,855 | 17,215 | 3,740 | 21,205 | 24,945 | 8,028 | 83,505 | 91,533 | 3,372 | 35,597 | 38,933 |
| Total Number of Redds | | **339** | | | **1,653** | | | **3,236** | | | **1,372** | |

Note: 1993 -1996 natural fall chinook spawner escapement totals for the Klamath River (excluding the Trinity River), were taken from the California Department of Fish and Game Klamath River basin fall chinook spawner escapement summary.

# SUMMARY

The total of 1,702 fall chinook redds observed in the fall of 1994 was a substantial increase over the 339 redds observed in 1993. The 3,249 adults and 625 grilse were the largest estimated number of spawners recorded since 1979. The 1979 mainstem Klamath River return was a mark recapture estimate based on 40 marked adults and 2 recoveries and did not consider spawners below the Trees of Heaven Campground.

The influx of spawners from IGH is a matter of great concern. Apparently, the hatchery was inundated by returns in 1994-1995 with insufficient staff and resources to retain or mark all returning hatchery fish. In order to sample throughout the run, the hatchery opened the ladder for 2 hour periods and returned excess fish back in the Klamath river. Initially adults were marked before returning them to the river, but due to the numbers of fish returning, the marking was abandoned (Hiser per. comm.). This policy forced surplus salmon to disburse and spawn elsewhere on the mainstem Klamath or nearby tributaries , thereby biasing native chinook spawning survey counts. Since the mainstem Klamath River escapement is based on natural spawning and there was an introduction of hatchery fish into the upper Klamath River and it's tributaries, the natural escapement estimate during 1994 and 1995 should be considered a mixed stock (hatchery/wild). In 1996, IGH retained all excess spawners. Continuation of this practice is essential for reliable estimates of natural escapement in the mainstem Klamath River and nearby tributaries.

Redds were located throughout the mainstem from IGH downstream to the confluence of Indian Creek. As with the 1994-1995 survey results, approximately 50% of the observed redds in 1996 occurred upstream from the Shasta River confluence to IGH. Spawning surveys conducted by the USFS on 14 November 1996 yielded an additional 19 redds from the confluence of Indian Creek to Independence Creek and 4 redds from Orleans Bridge to Big Bar. USFS redd counts in 1995 yielded 61 redds over four days of survey effort.

Redd substrate composition results from 1995-96 show redd substrate composition estimates consistent with previous survey data and within the optimal (1.3-10.2 cm.) substrate size range required by spawning chinook salmon (USFWS 1986). Average redd surface area, depth of pit, mound and adjacent depth remained within 1993-1996 spawning survey ranges. Point velocities (n=11) over redds ranged from a high of 3.99 feet per second (cfs) (1.22 ms) to a low of 1.76 cfs (0.54 ms) in 1995. Flow measurements over redds were not performed in 1996.

With development and restoration projects expected to continue throughout the Kamath River basin, questions surrounding the impacts by each activity on mainstem spawning habitat and escapement needs to be addressed and monitored. The vital information provided by the USFWS and USFS spawning surveys supplies fisheries managers with reliable yearly estimates of mainstem Klamath River fall chinook salmon spawning levels. Additionally, the continuation of the cataraft method to conduct "real time" spawning surveys provides timely spawning data and habitat observations necessary to aid in the evaluation of detrimental or beneficial activities on

chinook salmon habitat, particularly during critical spawning and egg incubation periods.

## REFERENCES

Bisson, P.A., J.L. Neilson, R.A. Palmason and L.E. Grove, 1982. A system of naming habitat utilization by salmonids during low streamflow. In N.B. Armantrout, ed, Acquisition and Utilization of Aquatic Habitat Inventory Information. Western Div., Am. Fish. Soc., Portland, Oregon. pp 62-73.

CDFG (California Department of Fish and Game), 1995, 1996. Weekly anadromous fish counts Iron Gate S/S Hatchery, Yreka, California.

Hubbell, P.M. 1993. Memorandum, Klamath River Basin fall chinook salmon spawner escapement, in-river harvest and run-size estimates, 1978-1992. California Dept. Fish and Game Sacramento, California.

Snyder, J.O 1931. Salmon of the Klamath River. California Department of Fish and Game. Fisheries Bulletin No. 34.

U.S. Dept. of the Interior. 1985. Klamath River Basin Fisheries Resource Plan. Prepared by CH2M Hill for the Bureau of Indian Affairs, Redding, CA.

USFS (U.S. Forest Service) 1977. An economic evaluation of the salmon and steelhead fisheries attributable to Klamath National Forest. Klamath National Forest. Yreka, California. 17 pp.

USFWS (U.S. Fish and Wildlife Service) 1986. Species Profiles: life histories and environmental requirements of coastal fishes and invertebrates. U.S. Fish and Wildlife Serv. Biol. Rep. 82 (11) . U.S. Army Corps of Engineers, TR EL-82-4.

## PERSONAL COMMUNICATIONS

Hiser, C. 1996. California Department of Fish and Game, Iron Gate Hatchery
Grunbaum, Jon 1995. USFS Happy Camp Ranger District.