Chinook Salmon Spawning Study
Russian River
Fall 2002

Sonoma County Water Agency
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INTRODUCTION

Summer flows in the upper Russian River are heavily influenced by releases from Lake Mendocino. Lake Mendocino impounds natural run-off from the East Fork of the Russian River and Eel River water diverted through the Potter Valley Project. An unusual rainfall pattern occurred during winter 2002 in which the Russian River watershed received normal rainfall (resulting in normal water releases from Lake Mendocino) while rainfall in the Eel River basin was below normal (resulting in restricted water diversions into Lake Mendocino). In addition, while Russian River rainfall total was "normal" for the year, the precipitation in the spring was below normal. Dry spring conditions lead to an early onset of irrigation demands. As a result of the diminished inflows and prolonged releases, the water levels in Lake Mendocino decreased dramatically.

In contrast to the bleak conditions at Lake Mendocino, the fall of 2002 was an excellent year for Chinook salmon (*Oncorhynchus tshawytscha*) returns throughout northern California. The Sonoma County Water Agency (Agency) had observed record numbers of Chinook salmon returning to the Russian River.

By October 14, 2002 Lake Mendocino had declined to a historically low level of 30,000 acre-feet (af), less than half its storage capacity. When lake levels fall below 30,000 af, the Agency has the discretion to significantly reduce flows in the river to prevent dewatering Lake Mendocino. However, by the time Lake Mendocino had reached the 30,000 af milestone, there where already over 1,000 Chinook salmon migrating up the Russian River.

The Agency was concerned that significantly reducing the flows could negatively effect Chinook salmon in the Russian River. Changes in flows can reduce water depths and thereby obstruct salmon migration, dewater spawning grounds, and cause mortality from poor water quality or indirectly from disease. The Agency's concerns where heightened by mass fish mortalities that occurred in the Klamath River in fall 2002 (CDFG 2003).

The Agency developed a plan to avoid dewatering Lake Mendocino while maintaining sufficient water flows for Chinook salmon. The plan included incremental reductions in flow releases from Lake Mendocino coupled with intensive monitoring of water quality and Chinook. Flow reductions would be curtailed if Chinook salmon appeared effected by the change in conditions. The Chinook Salmon Spawning Study, Russian River, Fall 2002 documented the largest run of Russian River Chinook salmon in recent history and the effects of reduced flows during the migration and spawning period of the salmon.

Life History

Russian River Chinook salmon follow the life history pattern of fall-run chinook, which is an adaptation to avoid summer high water temperatures. Adult salmon migrate from the ocean to spawn in rivers and large tributaries with freshwater in late summer and fall. Spawning occurs

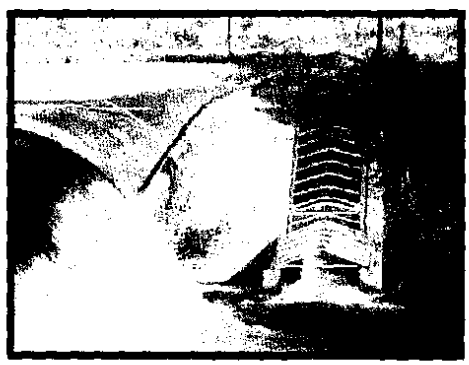
within a few days or weeks of arriving at a spawning ground. Adults create a nest, called a redd, by digging a shallow depression in the streambed with their caudal (tail) fin. Females deposit between 2,000 and 17,000 eggs in a redd that settle into the rocky substrate. Redds are usually located at the head of riffles with large gravel to cobble substrate to ensure oxygenated water flows to the eggs. Adults die soon after spawning. Eggs hatch within 4 to 6 weeks and young salmon emerge from the substrate in spring and move downstream within a few months. Young Chinook may rear in the mainstem of rivers or estuaries before heading out to sea where they spend between 2 to 4 years maturing before returning to their natal stream to spawn and complete their lifecycle.

Historic Runs

The historic occurrence of Chinook salmon in the Russian River is debated; however, the scant available sources suggest that Chinook salmon were rare in the river. Steiner (1996) compiled several sources from the late-1800s and early-1900s that suggested there were few Chinook in the Russian River. Stocking attempts began as early as 1881 with 15,000 Chinook planted in the mainstem without success (Steiner 1996 and USACOE 1982). Heavy planting in Dry Creek, starting in the 1980s, did not establish a viable run (Steiner 1996). Hatchery fish were primarily from Sacramento River and Klamath River stocks (Moyle 2002). The first population estimates were in the early 1960s at 500 spawning adults (CDFG 1965). By 1982 Chinook were considered "not currently established in the Russian River" except for occasional observations "possibly a vestige of prior attempts at establishing a viable population" (USACOE 1982). Also, by the 1990s Steiner (1996) concluded that there were currently few hatchery or wild Chinook salmon in the Russian River basin. However, recent observations indicate that Chinook salmon in the Russian River are higher than historic accounts. Over 1,300 adult Chinook were observed each fall during 2000 and 2001 at the Sonoma County Water Agency inflatable dam fish ladder (Chase et al. 2002). These numbers likely represent a portion of the entire Chinook run during each year. Also, recent genetic studies indicate that Chinook salmon in the Russian River are a unique wild run and not hatchery stock from outside the basin (Hedgecock et al. 2002).

METHODS

The Chinook Salmon Spawning Study consisted of underwater visual (dive) surveys for holding adult Chinook and redd surveys at spawning sites. Also, video monitoring of migrating adult Chinook was conducted as part of a Sonoma County Water Agency Mirabel Inflatable Dam/Wohler Pool Fish Sampling Program. The study area included the upper Russian River. The river was sectioned into 5 reaches based on gradient and surrounding topography, including Ukiah, Canyon, Alexander Valley, Healdsburg, and Dry Creek reaches. The study was conducted in fall 2002. The upstream



Inflatable dam (left) and fish ladder (right)

migration of Chinook salmon recorded by video monitoring was used to coordinate the timing of dive surveys, while video and dive observations were used to coordinate the start of redd surveys. Below are method details for the 3 components of the study.

Underwater Video Monitoring

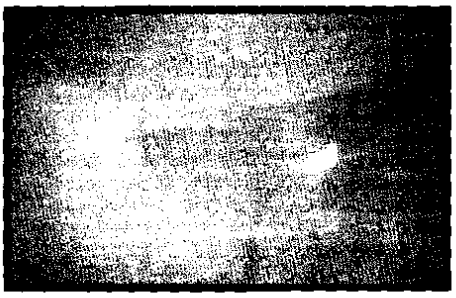
Underwater video cameras were used to document the number of Chinook salmon in the Russian River during the fall migration. Cameras were installed at 2 fish ladders located at the Sonoma County Water Agency's inflatable dam near Wohler Road Bridge, 12 km south of Healdsburg. Time-lapse cameras recorded the upstream migration of adult Chinook salmon. Video monitoring was conducted continuously, 24 hours a day, from August 12 through December 11, 2002. The video monitoring ended when heavy rainfall required the deflation of the dam. It is possible that Chinook salmon migrated after December 11 and would not have been documented.

Underwater video camera

Dive Surveys

Visual underwater (dive) surveys were conducted at selected large pools along the upper Russian River where adults were likely to hold during their upstream migration. Surveys were conducted weekly from October 9 to October 29 and on November 26. Pools sampled within each reach included:

- Ukiah Reach - Norgard Dam pool and 7 other pools
- Canyon Reach - Acapulco Rock pool, Squaw Rock pool, and 5 other pools
- Healdsburg Reach - Digger Bend pool, Healdsburg Dam pool, and 5 other pools
- Dry Creek Reach - Redwood Hole and 5 other pools



Dive survey for Chinook

The dive surveys were used to determine the presence or absence of holding Chinook and their physical condition. Crews of 3 to 4 biologists with snorkel gear were used to visually search for Chinook salmon. Sample pools were partitioned into parallel dive lanes running along the pool length. Divers entered the water at the downstream boundary of a pool, moved to a lane, and proceeded upstream. Lane partitioning reduced the possibility of missing fish observations between divers. Divers counted Chinook and noted their appearance, including spawning colors, presence of fungal growths, and overall health.

Redd Surveys

Redd surveys were conducted to estimate the number and determine the distribution of Chinook salmon redds. Surveys were initiated after video monitoring indicted a peak in adult Chinook salmon migration and dive surveys indicated adults had migrated to the upper Russian River. Redd surveys were conducted from the confluence of the East and West forks of the Russian River near Ukiah to the Redwood Hole located approximately 10 km downstream from the

confluence with Dry Creek near Healdsburg. The study area was surveyed once between November 4 and November 26. A crew of 3 biologists would survey a reach by kayak and visually search for redds along the streambed. Coordinates of observed redds were recorded using a global positioning system (GPS). Habitat characteristics of spawning sites (i.e., substrate size, water depth and velocity, etc) were qualitatively described.

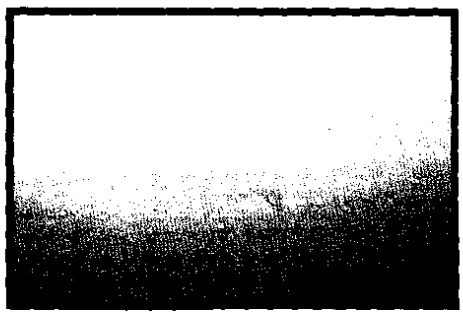
The number of redds counted during the surveys likely underestimated the true number of redds deposited during the entire fall 2002 spawning period. This underestimate is likely due to the single-pass survey method and difficulty in distinguishing redds. Additional redds could have been deposited after the survey of the study area. Also, identification of individual redds was difficult at high density spawning grounds because some redds were covered by overlapping redds. In the Ukiah reach the number of redds was visually estimated at several densely clustered sites.

Staff records GPS coordinate of redd

RESULTS

Video Monitoring

A total of 5,365 adult Chinook salmon were observed at the video monitoring station in fall 2002 (Figure 1). The first observation of Chinook were on August 20 and continued through the end of the monitoring on December 11. During the monitoring period there were 3 peaks in Chinook migration activity on October 1, October 16, and November 7. The latter peak was the largest 1-day observation of Chinook at 2,213 fish, or 41% of the observed fish. This peak appeared to be initiated by the first large rain event of the season and a substantial increase of river flows.



Chinook observed during dive surveys

Dive Surveys

Dive surveys were used to assess the upstream progression of migrating adult Chinook salmon prior to reaching spawning sites. The locations of large sampled pools are shown on Figure 2. Adult Chinook salmon were observed in a total of 5 pools in the Dry Creek reach, 7 pools in Healdsburg reach, 1 pool in Alexander Valley reach, and 0 pools in the Canyon and Ukiah reaches. These observations in the 3 lower reaches (Dry Creek, Healdsburg, and Alexander Valley) occurred from October 9 to October 29. Migration to upstream reaches (Canyon and Ukiah) likely began in early November. Spawning was observed during redd surveys in the Alexander Valley reach on November 4 and in the Ukiah and

Carcass found during surveys

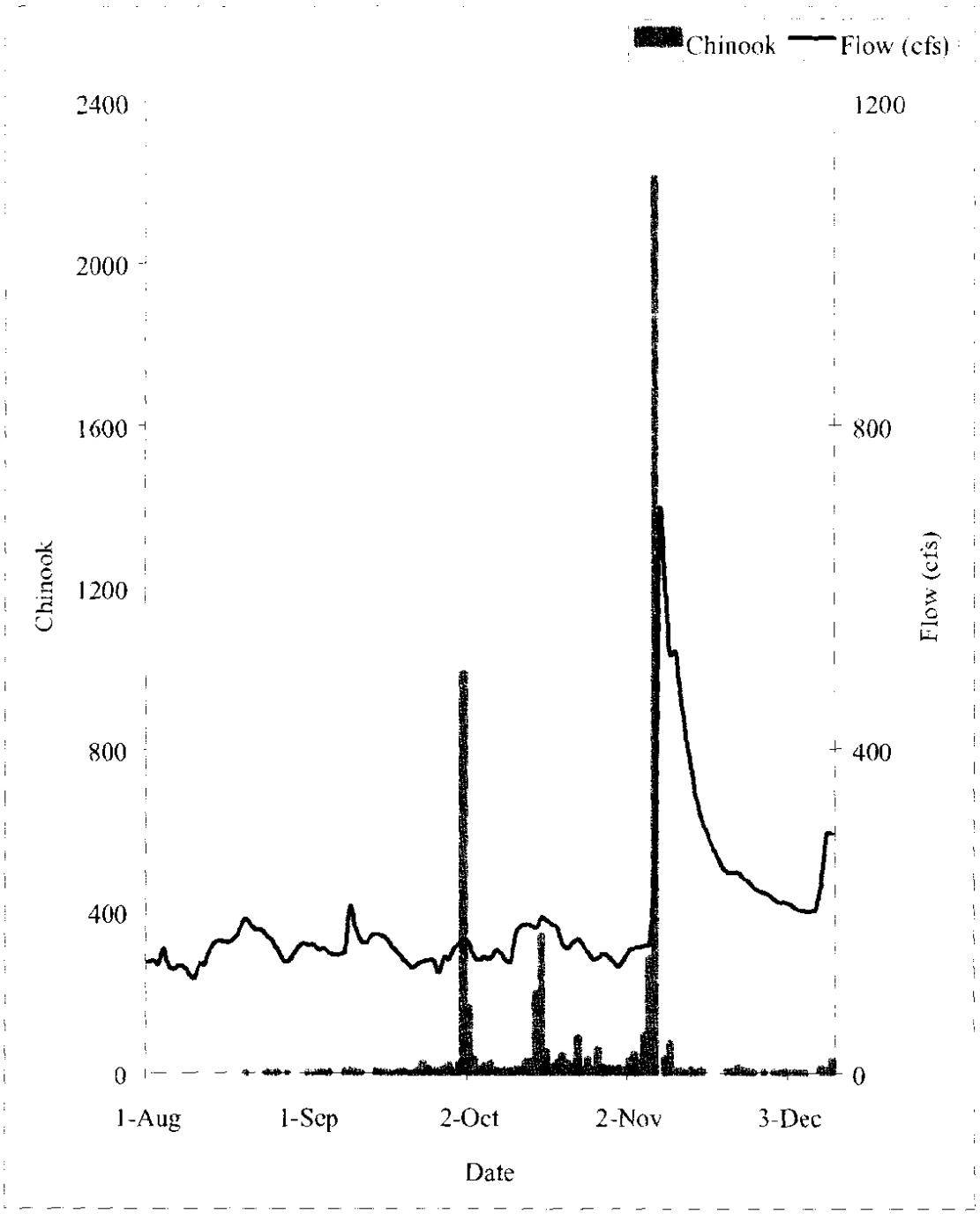
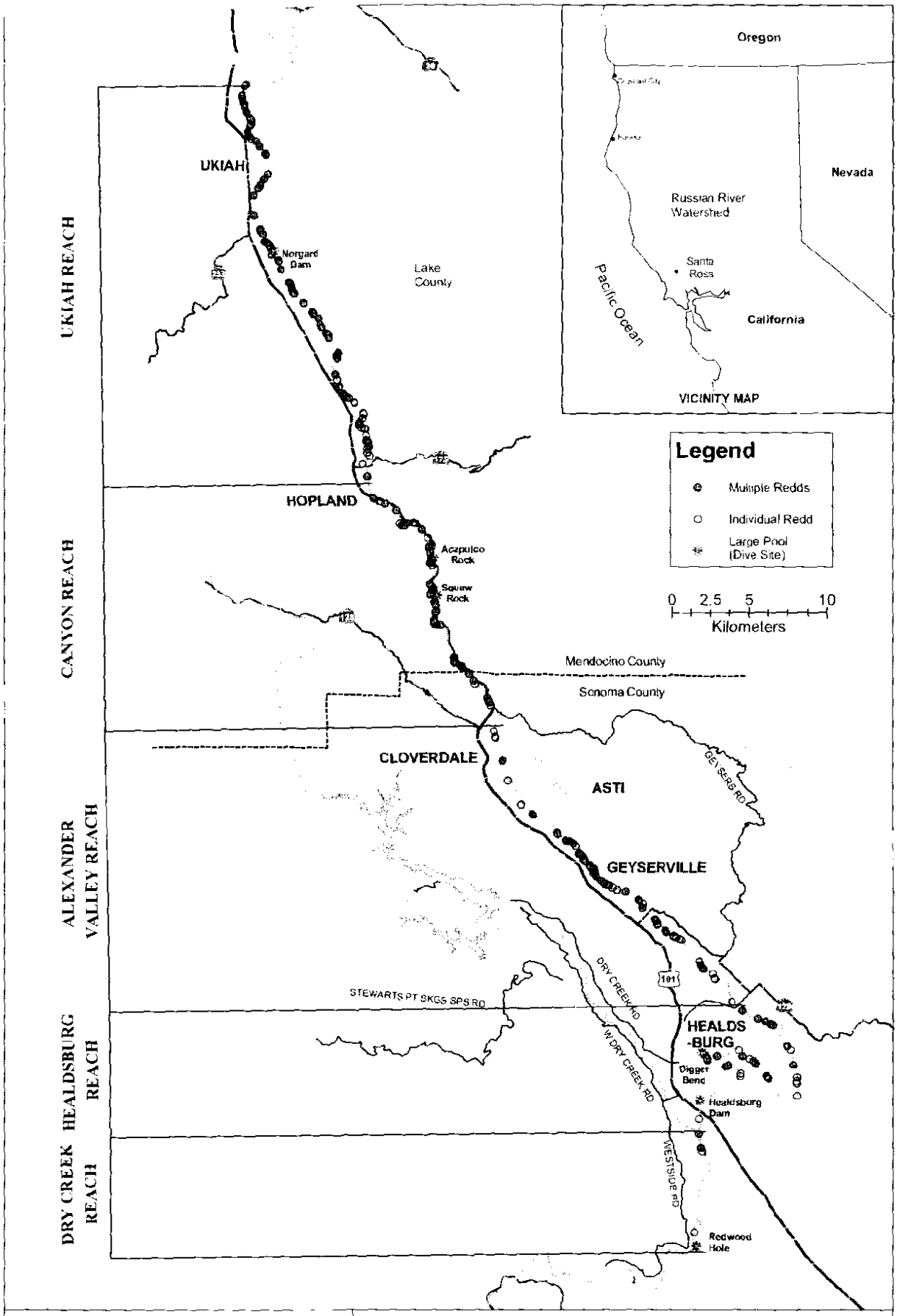


Figure 1: Chinook salmon observations at the Sonoma County Water Agency's inflatable dam fish ladder, fall 2002.



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Chinook Salmon Spawning Study, Russian River Fall 2002

Figure 2

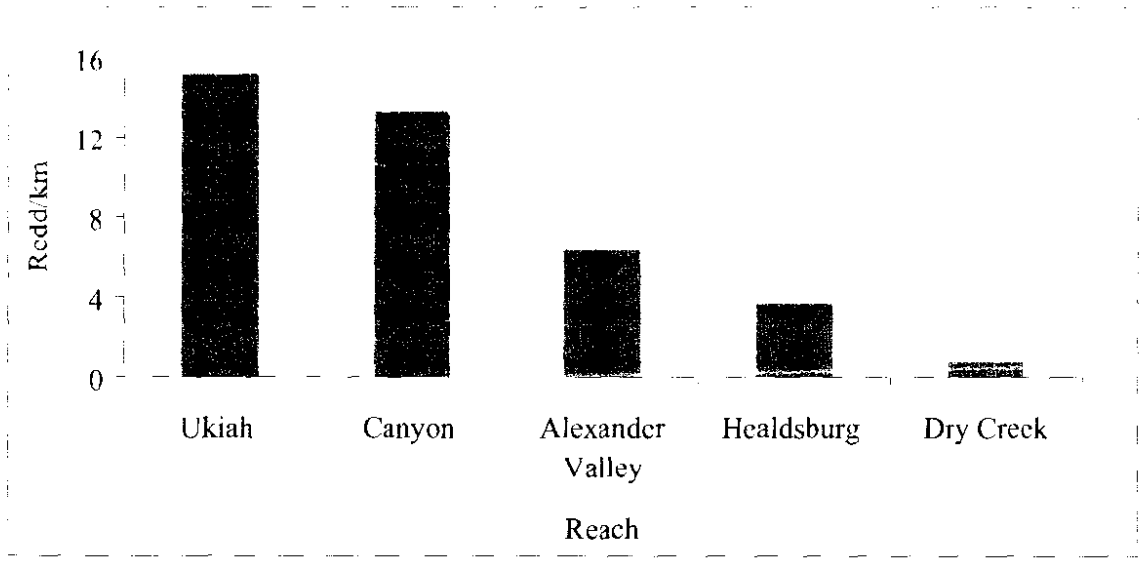

Figure 3: Chinook salmon redd occurrence along reaches of the upper Russian River.

Canyon reaches by November 18. See below for a discussion of spawning and redd findings.

The number of Chinook salmon observed in pools ranged from 1 to 250 adults. The largest numbers of Chinook were observed in larger pools with water depths greater than 4 m. The large pools with relatively high numbers of Chinook were located in the lower 2 reaches. One pool in the Dry Creek reach contained 150 adults, while two pools in the Healdsburg reach contained 30 and 250 adults. Also, most Chinook observed in pools appeared healthy, although a few adults had minor fungal infections.

Redd Surveys

A total of 1,038 Chinook salmon redds were observed in the upper Russian River between November 4 and November 26. The occurrence of redds increased upstream from Dry Creek reach to Ukiah reach (Figure 3). Dry Creek reach had the lowest frequency of redds at 0.7 redd/km. Healdsburg and Alexander Valley reaches had relatively low frequencies at 3.7 and 6.4 redds/km, respectively. The frequency of redds in the Canyon reach (13.3 redds/km) and Ukiah reach (15.1 redds/km) were greater than twice the frequency of redds in Alexander Valley reach located downstream from the Canyon reach.


Spawning riffle with several redds seen as light area in riverbed

The distribution of redds are shown on Figure 2. The relatively few redds observed in the Dry Creek reach were found near the upstream end of the reach near the confluence with Dry Creek. Redds in the Healdsburg reach were clustered in the center and upstream end of the reach. In the Alexander Valley, redds were clustered in the

center of the reach. Redds were distributed throughout both the Canyon and Ukiah reaches. Redds throughout the study area were found almost exclusively in riffle habitats with course gravel to small cobble substrate.

CONCLUSIONS

An unprecedented number of Chinook salmon were documented spawning in the upper Russian River in fall 2002. Historical accounts during the past century suggest that Chinook were nearly extinct in the Russian River. This study documented 1,038 redds over 100 km of river from the East and West Forks of the Russian River near Ukiah to below the confluence of Dry Creek near Healdsburg. Most of the redds were distributed in the upper Ukiah and Canyon reaches with densities greater than twice observed in the Alexander Valley and Healdsburg reaches and approximately 20 times higher than in the Dry Creek reach. The video monitoring observation of 5,365 Chinook, approximately one-fifth the number of observed redds, suggests that many more redds were deposited than observed. This discrepancy is probably due to the superimposition (overlapping) of deposited redds, spawning after the surveys were completed, and spawning in tributaries that were outside of the study area.

The Agency avoided a possible fish-kill similar to the scenario observed in the Klamath River in fall 2002. The incremental reductions in flows from Lake Mendocino did not appear to affect migrating or spawning Chinook salmon in the upper Russian River. The timing and flow rate decreases were closely monitored so as not to lower water depths in riffles that could obstruct the passage of Chinook during migration or dewater spawning grounds during spawning activity. Our study found that Chinook successfully migrated to the upper Russian River and spawned in relatively large numbers indicating that water conditions were adequate for adult Chinook to complete their lifecycle.

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