NAPA RIVER SALMON MONITORING PROGRAM

SPAWNING YEAR 2007 REPORT

AUGUST, 2008

PREPARED BY

JONATHAN KOEHLER
SENIOR BIOLOGIST
(707) 252 – 4188 X 109
JONATHAN@NAPARCD.ORG

CHAD EDWARDS
BIOLOGIST
(707) 252 – 4188 X 116
CHAD@NAPARCD.ORG

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ACKNOWLEDGEMENTS

The Napa RCD would like to thank all the landowners who granted us access to their property. We would like to thank John Williams, Robert Torres, Laurel Marcus, and Julie Beagle for their assistance with access. We would also like to thank Mike Napolitano and Craig Cooledge for their help in conducting fieldwork.

This monitoring program was funded by the Napa County Conservation, Development and Planning Department and a grant through the California Land Stewardship Institute.

Additional funding for underwater photography was provided by a grant from the Wildlife Conservations Commission of Napa County.

This report and reports from previous years are available online at http://www.napawatersheds.org

BACKGROUND

During the past six years, an estimated run of between 400 - 1000 fall-run Chinook salmon (*Oncorhynchus tshawytscha*) have spawned annually in the mainstem Napa River and several tributary streams (Koehler 2005; Koehler 2006; Koehler 2007). The Napa County Resource Conservation District (RCD) began an ongoing salmon monitoring program in 2003 to assess Chinook abundance, distribution, and spawning success within the Napa River basin. This report covers salmon activity in the 2007 spawning year, which began in late December and extended through early January 2008.

Very little is known about historical Chinook salmon abundance and distribution in Bay Area streams. In a recent review of existing fisheries information for the region, no conclusive evidence of historical Chinook salmon populations could be found for the Napa River basin (Leidy et al., 2005). However, based on analysis of natural channel form, hydrology, and ecology, the Napa River likely supported a large, sustainable population of Chinook salmon under historical conditions (Stillwater Sciences, 2002). Additionally, the geographic location of the Napa River at the entrance to the Sacramento/San Joaquin River systems makes it likely that wild Chinook salmon populations from these systems would naturally stray into the Napa River during favorable periods.

During the past 150 years, a combination of factors including reduction in spawning habitat, channel and floodplain alterations, and the introduction of exotic predatory fishes have all reduced the river's potential to support a large viable population of Chinook salmon. Today, there are approximately 25 miles of suitable spawning habitat being used by Chinook salmon in the mainstem Napa River. There are also approximately 15 stream miles within low gradient reaches of several large tributaries, which are suitable in some years depending on early season flow patterns.

METHODS

Spawner surveys were conducted following California Department of Fish & Game protocols as described in the California Salmonid Stream Habitat Restoration Manual (Appendix A). Redd locations were recorded by sampling reach and marked in the field with flagging. The excavated redd area was measured using a graduated gaff hook handle, and the specific type of habitat (pool, glide, riffle, run) where the redd was constructed was also recorded. Surveys were conducted in five survey reaches of the Napa River (Figure 1) between Oak Knoll Avenue and Zinfandel Lane.

A snorkel survey was conducted in the mainstem Napa River between Zinfandel Lane and the Oakville Crossroad in May 2008 to document the abundance and distribution of juvenile salmonids. A two person crew continuously swam downstream through this reach and recorded estimated abundance and species observations on handheld notebooks.

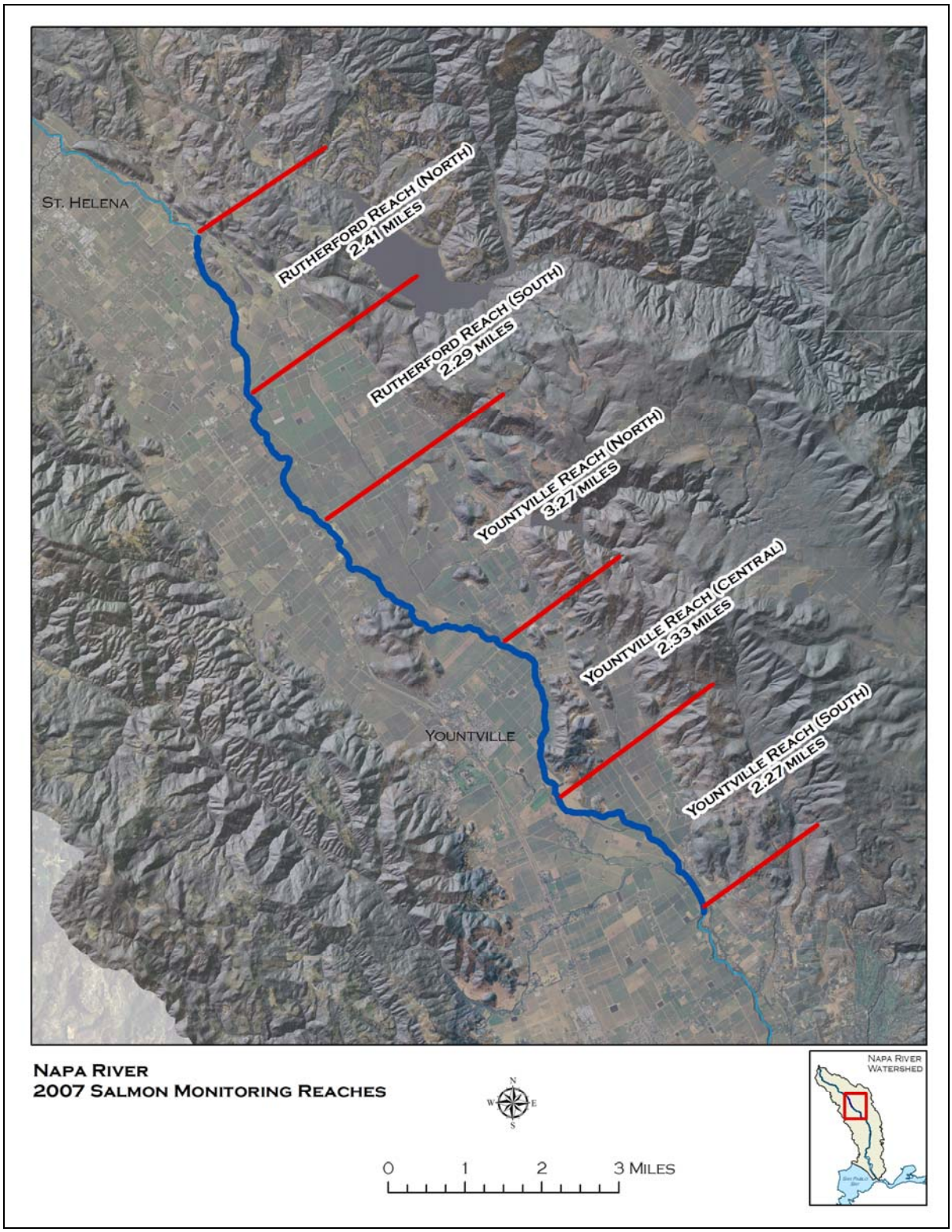

Figure 1. Location Map showing five sampling reaches along the mainstem Napa River. Note: Two additional surveys were conducted in Salvador Creek and Napa Creek as part of a separate monitoring effort.

RESULTS AND DISCUSSION

Napa RCD staff conducted a total of six spawner surveys in five sampling reaches of the Napa River between December 23, 2007 and January 3, 2008. We counted a total of 91 redds in approximately 12.6 stream miles, which equates to approximately 1.4 redds per 1,000 feet (Table 1). In each of the three previous years, we counted an average of 3.6 redds per 1000 feet. The 2007 spawning year was therefore the lowest count in four years of monitoring. However, 2007 represented an exceptionally high-effort year, as we had funding to cover several additional miles of river. These newly surveyed reaches had very low overall spawning densities compared with the Rutherford reach. Data from the Rutherford reach alone show a much less severe downward trend (Table 2). This suggests that the Rutherford reach of the Napa River is a core spawning area within the basin and that other areas of the river appear to be used less extensively during low abundance years.

Figure 2. Typical Chinook salmon spawning redd constructed in a pool-riffle transition.

The decline in the 2007 redd data may be at least partially attributed to the fact that we sampled a much larger stretch of the river in 2007 compared with previous years. When calculating the number of redds per distance surveyed (i.e. count-per-unit-effort), the less-utilized reaches in the Yountville area significantly reduced the overall count-per-distance. Therefore, given the current limitations of unpredictable funding and variable levels of effort from year to year, the best index of annual spawning success appears to be the Rutherford Reach, which has been consistently sampled for four years (Figure 3).

	Survey Reaches (Napa River)								
	Rutherford			Yountville					
Spawning Year	North	South		North	Central	South	Survey Reach Length (ft)	Total Redd Count	Total Redds per 1000 ft.
2004	X	Partial					19,129	62	3.3
2005	X	X					24816	99	4.0
2006	X	X			X		37,136	128	3.5
2007	X	X		X	X	X	66,367	91	1.4

Table 1. Summary of salmon spawner survey in all reaches from 2004 to 2007. An "X" indicates that at least one, and possibly more, spawner surveys were completed for the reach in a given year. Note: the decline in the redd count per 1000 ft. in 2007 may be attributed to the increased level of sampling effort in low-density reaches of the river.

Spawning Year	Survey Reach Length (ft)	Total Redd Count	Redds per 1000 ft
2004	19,129	62	3.2
2005	24,816	99	4.0
2006	24,834	103	4.1
2007	24,834	68	2.7

Table 2. Spawning redd counts for the Rutherford Reach alone from 2004-2007.

Spawning redds were observed most frequently in riffles (Figure 4). The median redd size was 4 m^2, with a range of 1m^2 -20m^2 (larger redds were typically counted as multiple redd complexes if several clearly defined excavation holes were apparent). Most redds were constructed in areas with gravel and small cobble substrates, however several redds, specifically those in glide habitats, were observed in areas with primarily sand and small gravel substrates.

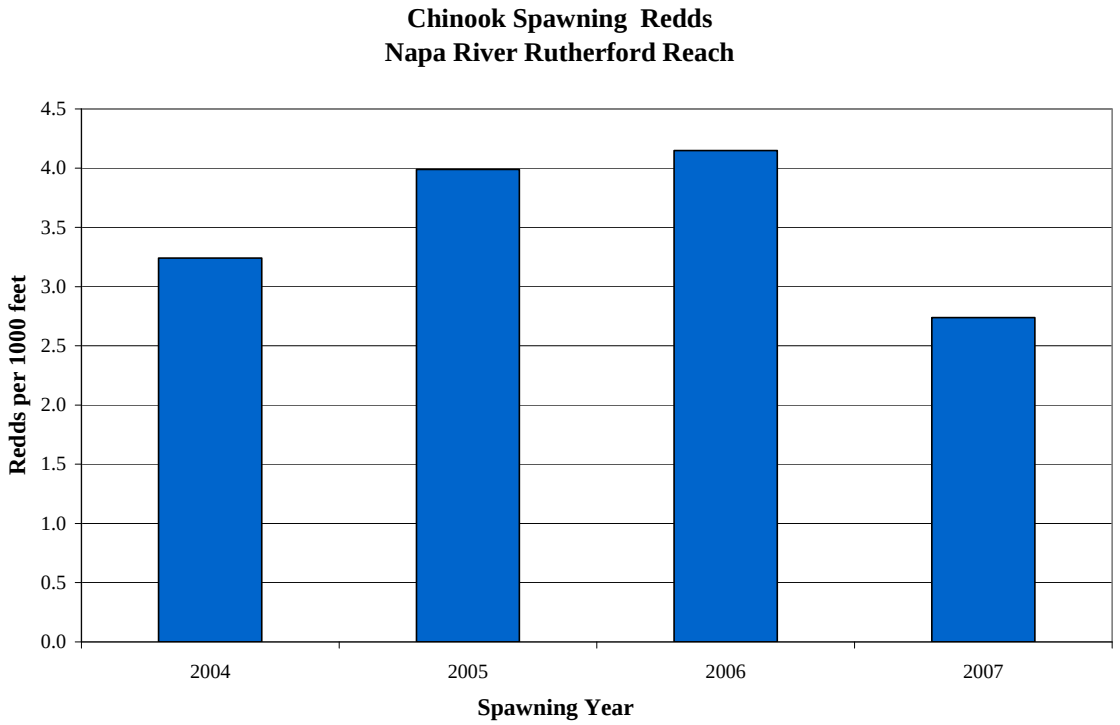

Figure 3. Redd density data from the Napa River Rutherford reach from 2004-2007. Note this graph represents only redds counted in the Rutherford reach where we have four years of comparable data.

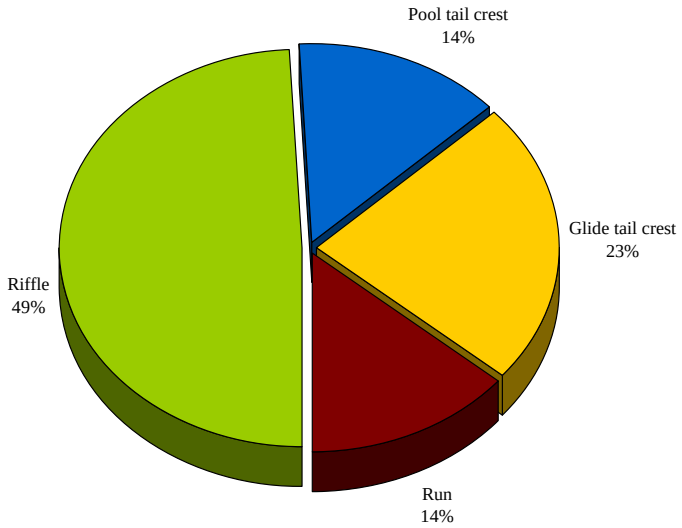

Figure 4. Redds by Habitat Type. Habitat type definitions given by the California Department of Fish and Game, California Salmonid Stream Habitat Restoration Manual, 2002. Tail-crest refers to the area at the downstream end of a pool or glide unit where it transitions into moving water (e.g. riffle, run, etc.).

A total of 45 live adult salmon and 26 carcasses and skeletons were observed during our surveys (Table 3). No carcasses or live fish had visible hatchery tags or marks (e.g. clipped adipose fins). Tissue samples were collected from 20 of the intact carcasses and sent to the National Marine Fisheries Service (NMFS) lab in Santa Cruz for genetic analysis (Figures 5 and 6). Ongoing genetic analysis is being conducted by a cooperative agreement between the RCD and NMFS to develop a parentage database for the Napa River population.

As in previous years, much of the spawning activity was concentrated in the northern-most sampling reach downstream of the Zinfandel Lane Bridge. Fish passage conditions at the Zinfandel Bridge were especially limited during the 2007/2008 migration period following a major storm that damaged the existing concrete jump-pool structure. It is likely that the high number of salmon spawning sites observed in this reach were a direct result of fish not being able to pass the bridge. The RCD and several local agencies are currently developing strategies to improve fish passage at Zinfandel Lane.

Survey Date	**23-Dec-2007**	**24-Dec-2007**	**26-Dec-2007**	**27-Dec-2007**	**28-Dec-2007**	**3-Jan-2008**	**Total Surveyed Distance**
Sampling Reach	NR-YN	NR-YS	NR-RN	NR-YC	NR-RS	NR-RN	
Survey distance (ft)	17,269	11,962	12,724	12,302	12,110	12,724	**79,091**
Survey distance (mi)	3.27	2.27	2.41	2.33	2.29	2.41	**14.98**
Live Chinook salmon observed	2	0	36	0	0	7	**45**
Chinook carcasses	0	0	4	1	1	14	**20**
Mean fork length (cm)	NA	NA	85	75	NA	80.25	**80**
Range fork length (cm)	NA	NA	85	75	NA	75-90	**75-90**
Fin clipped fish	0	0	0	0	0	0	**0**
Skeletons	0	0	5	0	0	1	**6**
Newly constructed redd count	11	0	53	12	12	3	**91**

Table 3. Summarized salmon spawner/redd survey data. NR-YN = Yountville Reach North, NR-YC= Yountville Reach Central, NR-YS = Yountville Reach South, NR-RN = Rutherford Reach North, NR-RS = Rutherford Reach South.

Figure 5. Female Chinook salmon carcass recovered in the Napa River. (December 27, 2007)

Figure 6. RCD Biologist, Chad Edwards, tagging a female salmon carcass and collecting a tissue sample for genetic analysis. (December 27, 2007).

RCD staff conducted a 4.7 mile snorkel survey of the Napa River between Zinfandel Lane and the Oakville Crossroad on May 15, 2008. Chinook salmon and steelhead parr (Figures 7 and 8) were abundant throughout the survey and appeared to be highly associated with moving water habitats (e.g. riffles, runs). Groups of 20-50 juvenile salmonids per riffle or run were common throughout the survey. Most fish were observed feeding with schools of native minnows and suckers in swift water. The average size of most Chinook parr observed was approximately 90mm (~3.5 inches). Steelhead parr appeared consistently larger than the juvenile salmon with an average length of approximately 100 mm (~4 inches). Very few parr were observed in the deepwater areas of pools or glides. These habitats were dominated by Sacramento pikeminnow (*Ptychocheilus grandis*), hardhead (*Mylopharodon conocephalus*), and Sacramento sucker (*Catostomus occidentalis*).

Figure 7. Juvenile steelhead (top) and Chinook salmon (bottom) in the Napa River near Zinfandel Lane. (May 28, 2008)

Figure 8. Juvenile Chinook salmon in the Napa River near Zinfandel Lane. (May 28, 2008)

CONCLUSIONS AND RECOMMENDATIONS

The 2007 spawning year for Chinook salmon was historically low throughout most of California. Our adult salmon counts from the Napa River basin reflect this downward trend in overall abundance; however some of the variation may be accounted for by differences in sampling effort from one year to the next.

It is important to note that although the total number of live fish, redds, and carcasses were all the lowest counts in four years of monitoring, we have observed exceptionally high abundances of juvenile salmon during the past two springs. This is likely a result of the mild hydrologic conditions that prevailed during the past two years and the lack of significant scouring winter flows during the salmon incubation and early rearing life-stages.

Although this monitoring program focuses on Chinook salmon, we also observed an exceptionally high number of steelhead redds and young-of-year steelhead in the mainstem in May 2008. We have regularly conducted snorkel surveys in these same reaches of the mainstem since 2001 and have never documented any significant steelhead spawning activity. The mainstem has been used primarily as a migration corridor for steelhead to more suitable tributary streams. However, it appears that steelhead spawning in the mainstem was widespread during winter and spring of 2008, and that most of the offspring of these spawning events reared in the Napa River. It is not known how many of these juvenile steelhead will survive the summer; previous studies have documented unsuitably high water temperatures throughout much of the river from June through October.

One possible reason for the high abundance of steelhead spawning in the mainstem this year may be attributed to low flows during much of the winter and spring adult migration period. As discussed above, the low amount of rainfall we received during this window in early 2008 may have prevented many fish from migrating upstream into smaller tributary streams. Additionally, the Zinfandel Lane Bridge was damaged during a winter storm in 2008 and posed a more significant barrier to steelhead than in years past.

Further monitoring efforts are needed to examine long-term trends and spawning success of Chinook salmon (and steelhead) in the Napa River. This monitoring strategy should include the following components:

- Continue annual spawner surveys using established protocols in the Rutherford reach and other reaches as landowner permission and funding allows.

- Conduct outmigrant (smolt) trapping in the mainstem Napa River to generate smolt production estimates and details on smolt size and timing. The RCD and partner groups are actively seeking funding to begin such a program.

- Continue collecting genetic data, specifically SNP information, which can be used to gauge spawning success and life history details that are currently unknown.

- Conduct snorkel surveys in spring within the established sampling reaches.

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APPENDICES

APPENDIX A: SALMON SPAWNER SURVEYS

CALIFORNIA SALMONID STREAM HABITAT RESTORATION MANUAL
FISH SAMPLING METHODS IV-7
California Dept. of Fish & Game

Salmon spawner surveys (also called salmon carcass surveys) are stream bank or above-water surveys. Surveyors usually walk along the stream bank and record the number of spawned salmon carcasses, redds, and live adults. This information is useful to:

- Determine if adults are returning to and spawning within a stream reach or basin area;
- Determine which species or races are utilizing the sample area;
- Determine relative abundance and distribution of carcasses, redds, live fish;
- Recover and record marked fish for mark studies;
- Identify preferred spawning habitat area.

Stream flow conditions can alter the timing and distribution of spawning activity from one year to the next. For annual comparison of data it is recommended that weekly surveys be conducted throughout the entire potential time range of spawning activity. Descriptions of spawning distribution within a basin should not rely on carcass counts conducted only during the assumed week of peak spawning. Spawner distribution within a stream system may be different for early versus late spawners.

The typical method for conducting spawner surveys is to walk along the stream bank or wade in the stream counting and recording all carcasses, redds and live fish observed. Carcasses are examined to determine species, sex, and/or missing fins. The fork lengths (FL) of fish are measured from the tip of the snout to middle of the tail to the nearest centimeter (cm). Counted carcasses are either cut in half or marked with a hog ring or metal tag to eliminate being counted in subsequent surveys. With prior DFG approval, the heads of carcasses with missing adipose (Ad) fins, are removed and retained for coded-wire-tag (CWT) extraction by DFG. All data is recorded on the Daily Salmon Spawning Stock Survey Field Form as indicated below.

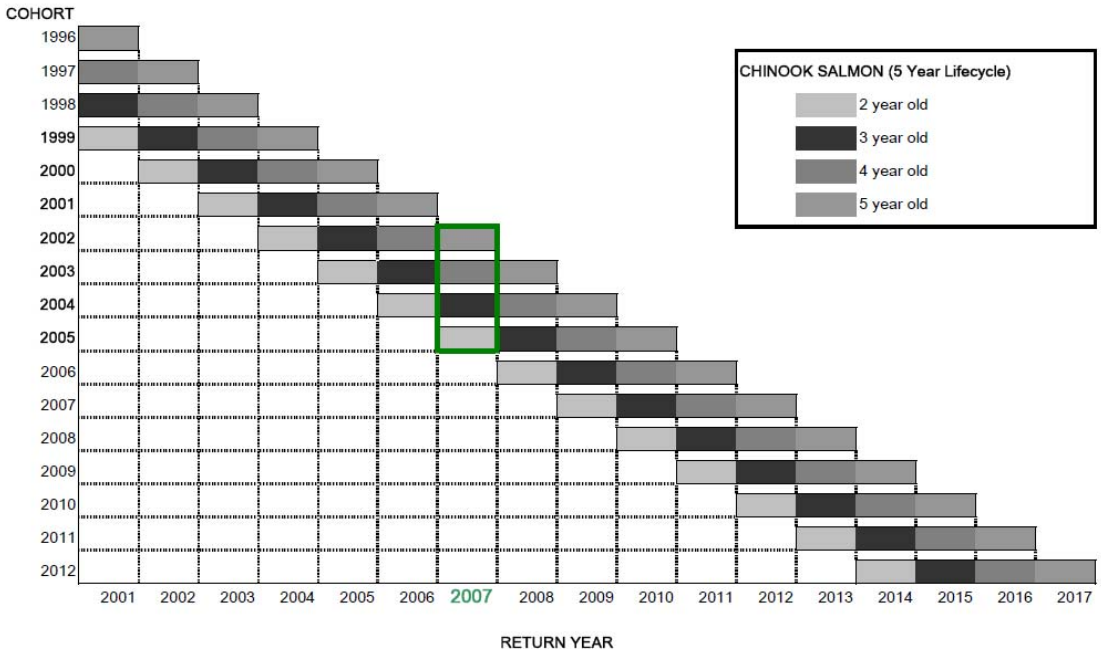
Tools and Supplies Needed

- Thermometer
- Gaff hook, handle marked in centimeters
- Waders with non-slip soles
- Pencils
- Waterproof field record forms
- Waterproof ID tags for fish heads
- Plastic "Ziploc" bags for fish heads
- Machete and hog-ring-pliers and hog rings
- Polarized glasses
- Stream map to indicate location of spawning activity

Stock Survey Field Form

1) **Stream** - Print the stream name.
2) **T-R-S** - Enter the township, section and range from the USGS quadrangle.
3) **Lat** - Latitude of the confluence of the stream from a 7.5-minute USGS quad sheet.
4) **Long** - Longitude of the confluence of the stream from a 7.5-minute USGS quad sheet.
5) **Quad** - Name of the USGS 7.5-minute quadrangle containing the confluence of the stream.
6) **Drainage** - Print the drainage name.
7) **County** - Enter the county in which the stream is located
8) **Starting location** - Enter the starting point of the survey (confluence with another stream, a highway mileage marker, a bridge, etc.)
9) **Lat and Long of the starting location** - Taken from a 7.5-minutes USGS quadrangle.
10) **Ending Location** - Enter the ending point of the survey; for example, the confluence with another stream, a highway mileage marker, a bridge, etc.
11) **Lat and Long of the ending location** - Taken from the 7.5-minute USGS quadrangle.
12) **Feet/miles surveyed** - Determine the distance of the survey using a map measurement device and a 7.5-minute USGS quadrangle. If the distance surveyed was measured using a hip chain, enter the distance in feet.
13) **Date of survey** - Enter the day's date: mm/dd/yy.
14) **Weather -** Make a check mark to indicate weather conditions: clear, overcast, rain. If weather conditions chancre during the survey, note this in the remarks section at the end of the page.
15) **Water clarity** -Estimate water clarity at the beginning of the survey. If water clarity changes during the survey, note this in the remarks section at the end of the page.
16) **Water temperature** -Water temperature taken at the beginning of the survey.
17) **Air temperature** - Air temperature taken at the beginning of the survey.
18) **Time** - Time when temperatures were taken.
19) **Crew** - Enter the names of the persons doing the survey.
20) **Number of live fish observed** - Enter the number of live chinook adults, chinook jacks (< 55 cm FL), coho, and steelhead observed. Identification of live fish can be very difficult. If positive identification is not possible, record the fish as an unknown.
21) **Number of carcasses examined** - Identify all carcasses to species and sex. Measure fork length in centimeters and record on the form. Examine all carcasses for adipose fin clips or any other fin clip. Mark all the carcasses using hog rings or cut carcasses in half after examination.
22) **Tag number of adipose-clipped fish and snout recoveries** - All carcasses must be examined for adipose fin clips. If the adipose fin is missing, the carcass may contain a CWT and the snout must be cut off and retained. Remove the snout by cutting across the head in the vicinity of the eyes; cut straight down from the eyes through the upper jaw and into the mouth cavity. Remove the snout in one piece. If unsure of the removal procedure; take the entire head. It is important not to lose the tag due to an improper cut. The project name, the recovery location, the species, length and sex of the fish, date and other relevant information must be recorded on a tag and wired to the snout. The project name will be recorded on the tag for later reference. The snout or head must be frozen in a zip-lock bag and taken to DFG, where the coded-wire tags will be excised and decoded. Snouts must be individually bagged.
23) **Other fin clips observed** - Record any fin clips observed other than adipose fins.
24) **Number of skeletons observed** - Any fish that cannot be measured, or any identifiable parts of fish found are considered skeletons.- If it is possible to identify the species, record it appropriately; if not, record it as unknown.
25) **Number of redds observed** - Record the number and location of observed redds. This can be difficult in areas of heavy spawning due to multiple redds and superimposition of redds.
26) **Remarks** - Add any, information discovered during the survey such as barriers, landslides, etc. Include any information necessary to clarify other entries on the field form.

APPENDIX B: Chinook Salmon Return Year Diagram



Chinook salmon return-year diagram depicting typical age class structure for returning adults. Salmon observed during the 2007 spawning year (green box) were comprised of fish from the 2002 through 2005 cohorts.

APPENDIX C: Spawner Survey Details

	SURVEY 1	SURVEY 2	SURVEY 3	SURVEY 4	SURVEY 5	SURVEY 6
Date	**12/23/2007**	**12/24/2007**	**12/26/2007**	**12/27/2007**	**12/28/2007**	**1/3/2008**
Stream	Napa River	Napa River	Napa River	Napa River	Napa River	Napa River
Start time	8:50 AM	9:20 AM	9:10 AM	9:00 AM	9:30 AM	9:10 AM
End time	12:15 PM	11:35 AM	12:10 AM	11:20 AM	11:21 PM	12:00 PM
Drainage	Napa River	Napa River	Napa River	Napa River	Napa River	Napa River
County	Napa County	Napa County	Napa County	Napa County	Napa County	Napa County
Start location	Yountville x-rd.	Oak Knoll Ave	Rutherford x-rd	Mondavi Vnyds	Oakville x-rd	Rutherford x-rd
End location	Oakville x-rd.	Mondavi Vnyds	Zinfandel Lane	Yountville x-rd	Rutherford x-rd	Zinfandel Lane
Start latitude	38.41825	38.368048	38.46452	38.39213	38.44664	38.46452
Start longitude	-122.35191	-122.303556	-122.41202	-122.33944	-122.38222	-122.41202
End latitude	38.440954	38.386541	38.49512	38.41825	38.46452	38.49512
End longitude	-122.394888	-122.331601	-122.42582	-122.35191	-122.41202	-122.42582
Survey Distance (feet)	17,269	11,962	12724	12302	12110	12724
Survey Distance (miles)	3.27	2.27	2.41	2.33	2.29	2.41
Weather	clear	clear	clear	overcast	overcast/rain	overcast/rain
Water clarity	> 4 ft.	> 4 ft.	> 4 ft.	>4 ft.	> 4 ft.	> 4 ft.
Air temp (c)	9	10	10	2	7.5	11
Water temp (c)	7.5	7.5	7	4.5	8	8
Crew:	Jonathan Koehler, Chad Edwards	Jonathan Koehler, Chad Edwards	Jonathan Koehler, Chad Edwards, Mike Napolitano, Craig Cooledge	Jonathan Koehler, Chad Edwards, Craig Cooledge	Jonathan Koehler, Chad Edwards	Jonathan Koehler, Chad Edwards