

1996-1997 REDWOOD CREEK SPAWNER AND CARCASS SURVEY

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## **SUMMARY**

Volunteers and GOGA aquatic ecologist surveyed Redwood and Fern Creeks, Marin Co. six times during the Winter 1996-1997 for spawning coho and carcasses. The index value for this coho year class is 58. Peak observations of live coho occurred in early January. We observed a high percentage of jacks among coho carcasses.

## **INTRODUCTION**

Redwood, Olema, and Lagunitas Creeks are three coastal streams within the Golden Gate National Recreation Area (GGNRA) management area that currently support self-sustaining runs of both coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*). In October 1996, coho salmon in the Central California coast region were formally listed under the Endangered Species Act of 1973 (as amended) (Act). Steelhead are currently proposed for listing as endangered in this area.

Because these anadromous fish spend parts of their lives in both freshwater and ocean, several factors such as ocean productivity and land-uses adjacent to streams may affect their abundance and distribution. The number of returning adults integrates factors that affect both ocean and freshwater survival.

Coho salmon in Redwood Creek were the focus of spawner and carcass surveys. Although both steelhead and coho are known to use Redwood Creek, the emphasis of the survey program was on coho salmon because of a life history pattern amenable for spawner and carcass counts. Unlike coho salmon, steelhead typically return to the ocean following spawning.

Point Reyes National Seashore manages certain GGNRA streams including Olema and Lagunitas Creeks. A similar spawner survey was conducted on Olema Creek through the use of volunteers from the Tomales Bay Association. One-time spawner surveys of Cheda Creek and the GGNRA section of Devils Gulch (tributaries to Lagunitas Creek) were conducted by GGNRA aquatic ecologist and volunteers. This data is not analyzed and resides in GGNRA files. In addition, surveys were conducted on Devils Gulch (State Park's section) and Lagunitas Creek by the Marin Municipal Water District.

### *Study Area Description*

The Redwood Creek watershed is a coastal drainage in southern Marin County, California (Figure 1). It covers 7.5 square

miles (PWA *et al.* 1994). Before discharging into the ocean, Redwood Creek joins with its last tributary, Green Gulch, to form Big Lagoon at Muir Beach and associated backwater areas. Barring uncharacteristic hydrologic events, Big Lagoon is connected to the Pacific Ocean during winter and spring months and closed during the remainder of the year.

According to historic records, peak streamflows may range up to 1780 cfs at Frank Valley Road (PWA *et al.* 1994). Like most coastal northern California streams, peak flows occur during the winter and spring with flows closely mirroring recent precipitation patterns. More recently, winter flows at the tail of the drought (1992-1993) ranged from 0.005 cfs to 275 cfs at the Pacific Way Bridge (PWA *et al.* 1994).

The survey area lies entirely within lands owned by the National Park Service, as part of the Muir Woods National Monument and the Golden Gate National Recreation Area, and the Mt. Tamalpais State Park.

In addition, the Redwood Creek watershed harbors several sensitive aquatic species. California red-legged frog (*Rana aurora draytoni*), a federally threatened species, has been found in the wetlands and backwater areas associated with Big Lagoon. The foothill yellow-legged frog (*Rana boylei*) was historically found in Redwood Creek, around Muir Woods. However, recent survey efforts have not found any foothill yellow-legged frogs (K. Freel, pers. comm., 1995; Ely 1993).

Suitability of spawning habitat. Winter water temperatures are within range of the reported temperatures for coho upstream migrations (Sandercock 1991). Late-winter water temperatures obtained from a Stowaway datalogger from mid-January to mid-March 1995 ranged from 7.5°C to nearly 13.5°C, with daily water temperatures varying by as much as 2°C.

Stream habitats suitable for spawning (riffles and some flatwater areas) become increasingly more common upstream of the Muir Woods Road (Highway 1) bridge crossing at the downstream end of the Mt. Tamalpais State Park (Table 1a). We also tried to qualitatively assess suitability of riffle and flatwater units for spawning by adult salmonids and successful emergence of fry based on the percentage of gravel or small cobble. A high percentage of fine sediments and sands decreases the percentage of fry emerging from nests; tests with nests containing 70% sand had only 8% fry emerging (Sandercock 1991). Ideally, core samples taken during the winter would provide the best information, but would be the most disruptive. Therefore, a modified Wolman pebble count was conducted within riffle and flatwater habitats throughout

Redwood Creek during Summer 1995. With the exception of the reach near Big Lagoon, most sites contained suitably sized spawning materials. The upstream most reaches, Kent-Dipsea and Dipsea-Bridge 4, had the highest percentage of gravel and small cobble (84 and 83%, respectively) (Table 1b).

#### *National Park Service Policy*

National Park Service's Natural Resource Management policies require the monitoring of natural resources under its stewardship "at regular intervals to detect or predict changes. The resulting information will be analyzed to detect changes that may require intervention and to provide reference points for comparison with other, more altered environments."

#### *Permits*

A NPS collecting permit was obtained for work conducted in winter 1996-1997 (GOGA-96-001). In addition, project survey activities were also conducted within the scope of the Park's natural resources project statement: Coho Salmon and Steelhead Preservation/Restoration (GOGA-N-081.000). Activities conducted on the threatened coho salmon require a Section 10 Endangered Species Act scientific research/enhancement permit. We have received a letter granting us an exemption from taking prohibitions of Section 9 of the Act until May 31, 1997 (letter from Hilda Diaz-Soltero, NMFS, to Brian O'Neill dated Jan. 8, 1997).

#### *Previous Work*

Information regarding the number of coho salmon and steelhead returning to Muir Woods National Monument (MUWO) have been collected by Muir Woods staff since 1944. Much of the acquired information came from anecdotal accounts. Winter surveys covering the known range of coho spawning within Redwood and Fern Creek have been conducted since the Winter of 1994-1995.

#### *Project Objectives*

The objectives of this spawning survey were:

- 1) To develop an index of annual escapement of coho salmon in Olema and Redwood Creeks for analysis of long-term trends.
- 2) To gather distributional information of spawning coho.
- 3) To determine population characteristics of returning coho

adults including size, age (optional), and sex.

- 4) To gather tissue samples for future analyses of genetic diversity of Redwood Creek coho runs.
- 5) To measure certain hydrologic conditions related to salmon run.

## **METHODS**

Live and carcass counts have been chosen as an index of the number of returning adults. Based on discussions with Sea Grant technical advisor (J. Waldvogel, pers. comm., 1996), we used a run size index based on the maximum one day total of live individuals and the cumulative number of carcasses. Sampling protocol developed for the Redwood Creek watershed in Humboldt County (Redwood National Park) by Dave Anderson and others were followed as closely as possible (Haux and Anderson, 1992).

### *Study Area*

Three survey reaches were established on Redwood Creek totaling 6.7 km (Table 2). Surveys on Redwood Creek started approximately 140 meters below the Pacific Way Bridge crossing above the Muir Beach parking lot (Station 1) to 0.5 km above bridge four in Muir Woods (Station 19, Figure 2). On Fern Creek, surveys were conducted from the confluence with Redwood Creek to the Lost Trail stream crossing for a total of 1 km.

### *General*

Spawning surveys were initiated on November 27, 1996. Weather permitting, surveys were conducted at 10-14 day intervals over a single day. Surveys concluded on January 30, 1997.

Surveys were conducted using two to three observers walking upstream and carefully inspecting banks, pools and instream woody debris for live salmonids or carcasses. Water clarity, gage heights, air and water temperatures were recorded during the surveys.

### *Fish Measurements*

When live fish or carcasses were encountered, the approximate locations were marked on a map using known landmarks. For observations of live fish, the species, sex, and size class (>50 cm or <50 cm) were recorded. In addition, we recorded activity patterns of fish as either "dead," "spawning," or "other."

For carcasses, scale and tissue samples, recapture status, species identification, fork length, and sex were recorded. We obtained fork lengths using a measuring rod (nearest cm). Wet weights were obtained using Ohaus spring balances (scale resolution 50 g) on intact carcasses. For freshly dead fish, we periodically checked our sex identification by looking for milt or eggs. Upon completion of measurements, fish were marked by punching several holes in the operculum. Hole punch tissues were placed in envelopes with scales. In addition, hole punch tissues were also placed in a preservative for use by the University of California's Bodega Marine Lab (Kate Bucklin) in their genetic analyses. Finally, the carcasses are returned to their original locations.

### *Redds*

Redds were difficult to determine in the field. Whenever possible, obvious redds were noted in the field to grossly describe spawning areas within Redwood Creek.

## **RESULTS**

### *General*

Peak number of live coho observations occurred during our January 8, 1997 with a total of 53 individuals seen (Figure 3). Using the maximum one day total of live individuals and the cumulative number of carcasses, the index value for the 1996-1997 winter season is 58 coho.

A total of 15 coho carcasses were recovered during the 1996-1997 surveys. No steelhead carcasses were found. No marked carcasses were recovered. Scale samples and operculum tissues were obtained from 15 coho carcasses.

Male coho carcasses ranged in fork length from 38 to 66 cm with a mean of 48 cm (Table 3). Female lengths ranged from 49 to 68 cm with a mean of 60 cm (Table 3). Figure 4 shows the length-frequency distribution of recovered coho carcasses. Results indicate that a high percentage of male carcasses (78%) were less than 50 cm.

On intact coho carcasses, wet weights were obtained in the field using spring scales for both male coho (n=7) and female (n=3). Although a small sample size, average wet weights (kg) for males and females was 1314 and 2217 g respectively (Table 3).

Observations of live coho salmon were not uniformly

distributed throughout the study reaches. As in the previous 2 years of survey, no coho or redds were observed in the lower portion of Redwood Creek below the Pacific Way bridge, an area within the scope of the Big Lagoon restoration project. Reach 2, which is located within Mt. Tamalpais State Park and lower MUWO, contained the most observations of live coho adults (Table 4). This observation is consistent with habitat inventories reporting a high percentage of riffle habitat units in this area.

### *Steelhead*

Like the past two survey seasons, steelhead were not seen until late January (January 30, 1997). However, more steelhead have been observed this season than previous seasons combined. At the conclusion of surveys in January, 17 steelhead were observed. Twelve of the steelhead adults were found in Fern Creek. Again, it should be emphasized that these results should not be used as an index of steelhead abundance. While steelhead may start to enter at the same time as coho salmon, steelhead entries in other streams can extend until mid-May, a much longer period than for coho salmon (Shapovalov and Taft 1954). In addition, Shapovalov and Taft (1954) noted that peak entry of steelhead occurred in early March. Our survey ended prior to the completion of the steelhead spawning season. We did capture one runback adult steelhead in our outmigrant trap on Redwood Creek in early April.

### *Trends*

Jacks. Precocious males (also called jacks) represent salmon that have spent one, rather than two, seasons in the ocean. Based on scale readings and length measurements of returning adults to a Santa Cruz County stream, Waddell Creek, Shapovalov and Taft (1954) found that returning coho less than 49 cm (fork length) were almost always jacks. Only 1.1% of the returning coho less than 49 cm spent two years in the ocean (Shapovalov and Taft 1954).

Based on carcass data, the percentage of jacks for winter 1994-1995, 1995-1996, and 1996-1997 are 16%, 0%, and 78% respectively. The reason for the high percentage of jacks for winter 1996-1997 is unclear. Sampling bias is unlikely to be the cause of the high percentage of jacks for winter 1996-1997. It is typically easier to see the larger carcasses in the woody debris or pool bottoms. Therefore, it is more likely that the actual percentage of jacks is underestimated.

Index of live and cumulative dead. Spawner and carcass

surveys along the entire length of Redwood Creek have only been done for three seasons: winter 1994-1995, winter 1995-1996, and winter 1996-1997.

Using the Waldvogel index of maximum number of live and cumulative number of carcasses, index values are 58 (winter 1994-1995), 27 (winter 1995-1996), and 57 (winter 1996-1997).

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