ANNUAL PERFORMANCE REPORT

FEDERAL AID IN SPORT FISH RESTORATION ACT

State: California Grant Agreement: F-51-R-13

Grant Title: Inland and Anadromous Sport Fish Management and Research

Project No. 22: North Central District Salmon and Steelhead Management

Job No. 2: Downstream (Out) Migration of Juvenile Salmon and Steelhead

Period Covered: July 1, 1999 through June 30, 2000

I. Summary: The North Central District encompasses portions of the central California and the southern Oregon/northern California coho salmon (*Oncorhynchus kisutch*) Evolutionary Significant Units (ESU). Of these two ESU's, coho salmon are Federally listed as threatened under the Endangered Species Act (ESA), and state listed as endangered in the central California ESU (California Endangered Species Act). Steelhead trout (*O. mykiss*) are Federally listed as threatened within the central and recently (August 7, 2000) within the northern California ESU. In essence, all anadromous runs of salmonids are listed within the North Central Sport District.

In an effort to assess timing, morphology, and magnitude of out migrating juvenile salmonids, fyke net traps were utilized on six coastal Mendocino County streams (installation and removal dates): Caspar Creek (3/7-6/9), Little River (3/17-6/12), Hare Creek (3/17-6/4), Wages Creek (3/17-6/5), Noyo River: South Fork (3/16-6/4) and North Fork of the South Fork (3/16-6/4). One out migrant trap was placed on Willits Creek (3/7-6/25), a tributary to Outlet Creek (see Table 1 for more trap temporal data). Data from Caspar Creek and Little River have been collected annually since 1989; one of the best historical records of past population and migration trends on the north central coast.

Willits Creek trap results elicited natural as well as unnatural perturbations germane to Outlet Creek chinook salmon (*O. tshawytscha*) populations as they relate to local water supply management, the Potter Valley water diversion Project, and consequences of atypical weather patterns.

II. Background: Salmon and steelhead resources in the North Central District once supported large sport and commercial fisheries. While these resources have precipitously declined since the late 1980's, direct and indirect take of these resources continue despite the increasingly regulated commercial salmon fishery. While attempting to address this dilemma, the California Department of Fish and Game (Department) has expanded its restoration program, in concert with projects such as this one, intended to provide the necessary data to evaluate restoration efforts.

III. Objectives: The purpose of this project is to evaluate the population dynamics (as they

relate to production upstream of the trap and only during the installation period) of downstream migrating coho, chinook, and steelhead in selected North Central District streams. Annual trends in downstream migration will also be addressed. Tables 1-3, figures 1-7 and appendices (summary data tables) follows text.

IV. Procedures: Modified fyke/pipe traps were installed to capture downstream migrating salmon and steelhead in Caspar Creek, Little River, Wages Creek, Hare Creek, Willits Creek and at two sites on the South Fork Noyo River in March, 2000.

The two traps on the Noyo River (one each on the South Fork and North Fork of the South Fork) were located approximately three hundred yards upstream of their confluence, near the Department's Sotuh Fork Noyo River Egg Collecting Station. The four remaining coastal traps were located low in their watersheds, similar to locations fished in previous years and below anadromous tributaries. The Willits Creek trap was placed behind the Willits High School, approximately 20 stream miles above the confluence with the Eel River, via Outlet Creek.

Sandbag weirs and wooden framed screens extended upstream towards shore from the mouth of each trap creating a funnel that nearly spanned the entire width of the stream. A small bypass channel was maintained for upstream migrating fish such as adult steelhead throughout the installation period. A live car that held fish for identification and measuring was attached to the end of each fyke net. All live cars were fitted with 1/4 inch mesh screen separators with the intent of reducing predation on small fish.

Traps "fished" seven days a week, weather and flow permitting. Each trap was serviced daily to reduce mortality. Each week, a length and weight sample size of 30 was targeted for salmon and steelhead young of the year (YOY) and coho yearlings (Y+) and 50 for steelhead yearlings (see Table 2 for salmonid measurement summaries). Live cars were fitted with a zippered escape passage, located in the rear of the live car, to facilitate passage of YOY through the trap after quotas were met and to reduce mortalities. Zippers were opened after the minimum sample size was achieved for each coho and steelhead YOY year class. At each trap location, water and air temperatures were recorded daily, as well as flow measurements (when flow meters were available).

A mark and recapture program for yearling age sized fish (smolts) was implemented this year at each trap location in order to measure the trap's vulnerability (efficiency) to capturing fish. Four unique fin clips (upper and lower horizontal and vertical caudal fin 4x4mm section removals) were rotated each week (stratum) beginning on Monday. In the case of Willits Creek, chinook YOY were clipped (marked) with 2 fin clips (upper and lower horizontal caudal fin 2x2mm section removals) because of their small size and strata varied when flow conditions influenced migration. Fin clips from salmon and steelhead were retained for DNA analysis. Marked fish were released 2-3 pool/riffle units upstream of each trap (crepuscular automatic release devices were not utilized and a handling mortality study was not conducted as it was assumed that equal mixing with unmarked fish was attained and the increased possibility of diurnal predation after handling was negligible). Recaptured fish were counted, measured, weighed and released downstream of the trap equidistant to the upstream release point. Table 1 summarizes out migration

trap production estimates that were generated using a preliminary version of software for stratified mark-recapture data (Bjorkstedt 2000).

V. Findings: This season's modest rainfall, except for a few high water events, enabled successful trap operation through most of the out migration trapping season which generally occurs from March through June. The trap on Willits Creek was operated through July in an attempt to resolve water issues as they relate to juvenile chinook migration through Little Lake Valley to the Eel River. Except for Willits Creek, traps were removed when the number of fish dropped below 10 yearlings per week.

A total of 3,040 coho yearlings were caught during the 99/00 season (down 53% from the 98/99 season) amongst all six Mendocino County coastal traps. The mean coho Y+ count between March and June was 507 (down 54% from 98/99) and ranged from 28 at Wages Creek to 1,346 smolts at Caspar Creek. As coho adhere to a three year life history cycle, downstream migration trends are more accurately compared by generations at three-year intervals (Figure 1). Little River 99/00 coho numbers increased 36% (682 compared to 500 smolts) from the 96/97 season. Caspar Creek coho smolts increased comparably (41%) from 953 in 96/97 to 1346 in the 99/00 season. The variability across and within year classes for juvenile salmonids might be an artifact of using the fyke net design in watersheds that produce low numbers of smolts and "flash" off water quickly. Heavy precipitation and the subsequent runoff into small Mendocino County coastal streams often overwhelm the fyke net and its weir panels. While on the other extreme, late season low flow may not prevent fish from recirculating out of the live car and fyke net. Both situations render this design as suspect when enumerating smolts during early and late periods of out migration.

Figure 2 depicts the weekly relative cumulative counts of out migrating coho as varying almost 1.5 months between the 50% attainment of counts between Caspar Creek and the Noyo locations; occurring from the middle of March to early May. However, the 98/99 study revealed that out migration for coho begins four to five months earlier. Conversely, 50% of the Wages Creek coho count (28 smolts) was accounted for within one week (4/10-4/17/00).

Trap locations recently added (within the last three years) to the monitoring program (South Fork Noyo River and North Fork of the South Fork Noyo River, Hare Creek and Wages Creek) do not lend themselves to generational trend analysis. The South Fork Noyo River trap, which caught the greatest number of coho smolts last year (2,766), produced 79% fewer in 99/00 than the previous year (Figure 3). The other coastal basins, for which this is the third trapping year, all showed reductions in migrating coho populations in 99/00. The presence of coho smolts at Wages Creek is encouraging after three consecutive years of juvenile coho plantings by the Department in 1995, 1996 and 1997.

A total of 2,945 yearling steelhead (down less than one percent from last year's total of 3,201) was captured amongst all coastal traps during the 99/00 season. Caspar Creek

steelhead yearlings numbered 622, down 10% from the previous season's count of 694 (Figure 4). While this remains less than the 1993 peak count of 1,193 fish, it is substantially higher than the 14 year average of 460 fish. The Little River steelhead yearlings, totaling 467, was identical to last years's count, recovering from its alarming dip of 277 fish two seasons ago. However, Little River steelhead populations remain considerably lower than the peak count of 1,635 fish in 1990 and the 14 year average of 832. With a 71% increase from last year's total count, the North Fork of the South Fork Noyo location weighed in with a dramatic increase of counted steelhead at 682 (Figure 5). The stability of higher steelhead counts at Hare Creek might be attributable to the trap's location; one mile downstream from the original installation for the past two of three total trapping years. Figure 6 depicts the weekly relative cumulative counts of out migrating steelhead as more consistent (lines spaced close together) between watersheds than for coho but occurring during a similar period (mid March to mid May). However, the 98/99 study revealed that out migration of steelhead begins four to five months earlier.

In addition to enumerating smolts, chinook, coho, and steelhead YOY were counted and sampled at each trap site. Coho and chinook fry emerge from spawning gravels in late winter, followed by steelhead, which continue to emerge throughout the spring. Juvenile coho and steelhead reside in their natal streams for a year or two (sometimes longer for steelhead) before they enter the ocean. Chinook fry, however, begin their out migration shortly after emergence. Losses of high flow refugia, in conjunction with excessive sedimentation and elevated water temperatures can have catastrophic effects on this sensitive life stage. Figure 7 is a weekly relative cumulative count of out migrating chinook and steelhead YOY in Willits Creek. The peak migration count (444, down 94% from last year's peak weekly count of 7,600) took place during the week beginning April 10 (almost identical to last year's timing), with another spate of migration in the week beginning May 1. These bimodal pulses of migration might be an artifact of the sporadic precipitation pattern during the previous spawning season. Chinook adults most likely spawned on both ends of the period typified by low precipitation, low flows, and frigid temperatures. The upper Eel River watershed received " normal" precipitation during November and the first week of December, 1999. The remainder of December, and most of January 2000, was typified by little or no precipitation and below " normal" day and night temperatures. These particularly low flows may have exposed some of the Chinook redds and possibly caused egg mortality. Normal precipitation resumed near the end of January and continued through February. In December, some of the local tributaries could not be surveyed for adult spawning chinook as stream surfaces were frozen.

Table 3 is a matrix of weekly chinook YOY fork lengths by 2mm size classes. For the first half of the trapping season, chinook YOY lengths ranged little more than 8-10mm while progressively growing 1-2mm a week. During the last half of the season, however, measured chinook length ranges nearly doubled that of the first half of the migration season. The cessation of counts in conjunction with wider ranges in length frequencies suggest that chinook migration rates slow as flows subside. Although this may seem obvious, the point serves to illustrate how timing and adequate water supply are paramount when managing water diversions around the chinook out migration period.

Previous studies conducted on the Eel River estuary suggest that chinook salmon juveniles

arrive at the estuary in the first half of July. This presents a problem for Outlet Creek as our data suggests that chinook continue to migrate out of Willits Creek during the first two weeks of July while still having to thwart several hundred river miles in order to reach the estuary. Concurrently, mainstem Eel River and lower Outlet Creek water temperatures had increased, creating a potential thermal migration barrier. Night temperatures at these locations registered only slightly lower than the daily temperatures; further confounding the problem as this is the most likely time when fish migrate. Moreover, flow at that time in the mainstem Eel River (approximately 5.0 cfs, at the mouth of Outlet Creek) was low, further endangering migration. The cumulation of these individual perturbations bodes no good for juvenile Chinook in their completing the journey to the Eel River estuary.

Representatives from the Department had consulted with PG&E about this situation last year. PG&E, at that time, agreed to release additional water from Cape Horn Dam to accommodate fishery concerns. The result most likely shortened the amount of time it would have taken to migrate to the Eel River estuary. Moreover, the additional flow produced turbidity which may have afforded extra cover from predators such as the non-native pike minnow.

VI. Recommendations: It is recommended that this project continue in its trend analysis. The listings of coho, steelhead and chinook require this type of funding, when Department resources are low, in order to address future listings and management recommendations.

With each additional year of trapping we continue to learn more about problems facing our salmonid populations. The information has also helped fisheries biologists, game wardens, county planners, and timber harvest reviewers with specific information requests pertinent to activities that affect salmon and steelhead in the north coast area.

VII. Estimated FY 98-99 Job Costs: $32,797.

VIII. Preparer: Scott Harris, _____, Associate Fishery Biologist

Literature cited

Bjorkstedt, Eric P. 2000. DARR (Darroch Analysis with Rank-Reduction): A method for analysis of stratified mark-recapture data from small populations, with application to estimating abundance of smolts from outmigrant trap data. U.S. Dep. Commer., NOAA, NMFS, SWFSC, Admin. Rep., Santa Cruz, SC-00-02. 261 Kb, 28 p.