Steelhead (*Oncorhynchus mykiss*) and Coho Salmon (*Oncorhynchus kisutch*) Juvenile Population Estimations and Predictions in the Noyo River, California Spring and Summer 2001

Prepared By

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Abstract

Modified fyke/pipe trapping and April-June resident population studies in the Noyo River were conducted during spring and summer 2001 to estimate juvenile and young-of-the-year (YOY) steelhead (*Oncorhynchus mykiss*) and coho (*Oncorhynchus kisutch*) population abundance, size, age, survival, migration timing, and distribution. Information was collected on all species captured and a simple population model was used to predict YOY steelhead populations based on adult female estimates from spawning surveys. Seven traps were placed in the Noyo River in late-March and checked daily until 1 July 2001. All steelhead, coho, and chinook salmon >50 mm were marked with weekly and trap-specific freeze brands. Fish < 50 mm fork length were counted. Marked fish were released above traps and recaptured fish were released below the traps. Modified fyke/pipe population estimates were computed using a maximum-likely-hood estimate for stratified populations. Populations were estimated by summing all trap estimates and using a two-trap mark-recapture method. One hundred meter reaches above and below each trap site were electro-fished four times between April and July 2001. All steelhead and coho >50 mm were marked with site and time specific freeze brands and released. Fish < 50 mm were counted and released. Resident population estimates were computed using the Jolly-Seber method for each reach and expanded to estimate stream resident populations. Steelhead populations were estimated by summing the trap and stream estimates. Steelhead YOY populations were predicted using the number and size of females estimated from spawning surveys and a length/fecundity relationship to estimate the number of eggs in each stream reach. An estimate of 80% survival from egg to fry was used to calculate the number of fry expected in each stream reach and stream specific estimated probability of survival from Jolly-Seber population estimates was used to predict the number of YOY present in July. Steelhead population estimates ranged from 73,114 (SD = 29,446) for the summation of individual traps to 290,059 (SD = 69,574) for the two-trap method. Coho population estimates ranged from 26,756 (SD = 5,229) for the two-trap method to 25,029 (SD = 6,121) for the summation of individual traps. Steelhead population estimates for the summation of individual traps and the two-trap were not significantly different (ANOVA f = 0.11, p = 0.89, n = 15).

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[1]Steelhead Research and Monitoring Program Report No. FB-10-Draft. November 2001. Philip K. Bairrington Senior Biologist Supervisor, California State Department of Fish and Game, 2030 1st Street, Suite 9, Eureka, CA 95501.

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Capture probabilities were not significantly different between steelhead and coho salmon > 50 mm ($t = -0.76$, $p = 0.46$, $n = 5$). Coho and steelhead catch and capture probabilities were generally weakly associated with stream flow or water temperature. Rearing YOY steelhead populations ranged from 0.0 to 6.59/m. On average 49.4% of the estimated steelhead YOY, 60.4% of the Y+, and 72.5% of the Y++ populations did not migrate during the study. Survival of YOY steelhead ranged from 0.07 to >1.0. Survival estimates for Y+ and Y++ steelhead ranged from 0.09 to >1.0 and 0.04 to > 1.0, respectively. Year 2000 YOY to 2001 Y+ survival ranged from 0.01 to> 1.0. Year plus steelhead and coho migrated earlier in the year while YOY steelhead moved throughout the study period. The individual trap YOY and Y+ population estimates from 2001 were not different than 2000. Rearing YOY and Y+ population estimates for stream segments were not different between 2000 and 2001. Estimated and predicted YOY steelhead populations were not significantly different during 2001 or between 2000 and 2001 adding confidence to the population model and spawning survey estimates of adult females. The steelhead population model developed for the Noyo River during 2000 may be applicable to other rivers. Downstream movement and resident population monitoring could continue in the Noyo River to follow cohorts through successive life stages, which may allow for detection of population bottlenecks.

Introduction

Many salmonid populations in California are considered at risk of extinction and are listed or are proposed for listing under the Federal Endangered Species Act (ESA) (Higgins et al. 1992, Nehlsen et al. 1991, Federal Register 1996, Huntington et al. 1996, Federal Register 2000). In response to the 1996 proposed ESA listing of steelhead (*Oncorhynchus mykiss*), the State of California Department of Fish and Game (CDFG) entered a Memorandum of Agreement (MOA) with the National Marine Fisheries Service (NMFS) in 1998 to provide improved conservation and management of North Coast steelhead (Federal Register 2000). The MOA, in part, commits CDFG to develop and implement a program directed at monitoring, evaluating, and adaptive management of North Coast (Northern California Evolutionary Significant Unit-ESU) steelhead. Since 1998 CDFG has taken significant steps to implement and expand the steelhead-monitoring program (Federal Register 2000) including development of the North Coast Steelhead Research and Monitoring Program (S-RAMP), implementation of SB 271, and changed harvest regulations and hatchery practices. The implementation of S-RAMP began in July 1999. However, in June 2000 NMFS formally listed northern California ESU steelhead as Threatened Species under the ESA (Federal Register 2000). The listing, by in large, is due to the failure of the California Board of Forestry to make significant changes in timber harvest regulations. This report summarizes S-RAMP's second year of study on the Noyo River.

Little information exists for the majority of steelhead stocks in California and basic life history, biological, and abundance trend information is needed to understand the nature and character of these populations (McEwan and Jackson 1996). The Eel River is the only stream in the northern California ESU for which recent counts of winter-run steelhead exist (CDFG 1998). Four key parameters for assessing viable salmonid populations are abundance, population growth rate, population spatial structure, and diversity (McElhany et al. 2000). Juvenile abundance, due to the relative ease of data collection, is the most common measure of salmonid abundance in California (Prager et al. 1999). This type of work is rated very desirable and of high cost by Prager et al. (1999). The NMFS recommends continued estimation of juvenile abundance combined with estimates of adult abundance and studies relating juvenile and adult abundance (Prager et al 1999). Information on life stage-specific survival may help assess population bottlenecks.

Existing young-of-the-year (YOY) and juvenile steelhead emigration information for coastal Mendocino County is summarized in Gallagher (2000). These monitoring programs were limited to eight local rivers and streams and generally collected to monitor coho emigration and rearing or examine enhancement programs. Gallagher (2000) summarized existing over-summer resident assessments for coastal Mendocino County Rivers and streams. In general, these studies report estimates of fish numbers without error estimates. Krebs (1989) states that a basic rule of descriptive statistics is to never report an ecological estimate without some measure of the possible error. There are numerous methods to estimate emigration and over-summer resident populations of salmonids. Manning (1998) used the Peterson mark-recapture method to estimate emigration and a modified Hankin and Reeves (1988) approach to estimate over-summer resident populations in the Little North Fork Noyo River. The Peterson method assumes, among other things, that the population is closed (i.e. no migration or emigration) which is clearly not the case for smolting salmonids. Darroch (1961) introduced a maximum-likelihood estimate for stratified populations, similar to the Jolly-Seber method (Krebs 1989), where stratification attempts to overcome problems with other methodologies due to non-random mixing and variable catchability Dempson and Stansbury (1991). The Darroch (1961) method was used by (Dempson and Stansbury 1991) to estimate Atlantic salmon smolt populations using a two trap stratified mark-recapture design. They had a 20% recapture rate and population confidence levels of < 8%. Thedinga et al. (1994) used a two-trap mark-recapture program to estimate salmonid smolt populations in Alaska using trap efficiencies and short-term survival estimates to determine population sizes and calculated variance in population levels using bootstrap techniques. A software program (Darr) using the Darroch (1961) method for estimating emigrating populations and trap efficiencies in small populations is under development (E. Bjorksted, Pers. Comm.). Over summer resident populations can be estimated, including estimates of error, using a variety of methods including removal, mark-recapture, and stratified snorkeling combined with electro-fishing (Hankin and Reeves 1988). Assumptions involved with these methods are outlined in Brower and Zar (1984), Krebs (1989), and Hankin and Reeves (1988), respectively.

The purpose of the 2001 fyke/pipe trapping and April-June resident population surveys in the Noyo River was to quantitatively estimate juvenile and YOY steelhead population abundance, size at age, survival, migration timing and distribution, and continue to evaluate the utility and efficiency of trapping and electro-fishing for this purpose. In addition, information was collected to estimate similar parameters for coho populations in the Noyo River. Information was collected on all species captured in the river during these studies. A simple population model developed by Gallagher (2000) was used to predict YOY steelhead populations from adult female estimates from spawning surveys. Estimates of year old steelhead (Y+) were compared to YOY estimates from Gallagher (2000) to examine cohort survival.

Study Area

The Noyo River watershed (Fig. 1) is a forested, coastal watershed in Mendocino County, California, which drains approximately 260 km^2 immediately west of Willits. The Noyo River flows through the coast range and into the Pacific Ocean at Fort Bragg. The Noyo River was selected to conduct a pilot YOY and juvenile steelhead mark-recapture program to estimate various population parameters and the ability of trapping and electro-fishing to produce these metrics. The Noyo River was chosen because, 1) a significant proportion of the watershed is in Jackson State Demonstration Forest, 2) the remainder of the watershed is primarily owned by two timber companies, 3) CDFG operates the Noyo River ECS on the South Fork Noyo River, 4) CDFG has conducted coho studies on the South Fork Noyo since 1986, and 5) CDFG has implemented many different types of habitat improvement projects in the South Fork Noyo River for many years. In addition, the Noyo River watershed is subject to several recent changes in management including no harvest of wild adult steelhead, no artificial propagation of steelhead, and different land uses due to different landowner ownership.

The Noyo River watershed is unique in Mendocino County because approximately 19% of the basin is owned and managed by the California Department of Forestry and Fire Protection (CDF) as a demonstration forest (the South Fork). Other major landowners in the basin include the Mendocino Redwood Company (the upper watershed) and The Campbell Group (along the main stem).

Study Sites

Fyke Trapping

Seven fyke net trapping sites were selected in the Noyo River to enumerate steelhead and coho salmon populations, determine population parameters, and further evaluate trapping methods during 2001 (Fig. 2). Trap sites were selected based on access, ability to install the traps, and were located close to the confluence of the stream of interest. Traps were placed in Hayworth Creek (HWC) at rkm 43.6, at Madsen Hole (MSH) in the main stem Noyo below the South Fork at rkm 6.3, in the main stem Noyo above Redwood Creek (MSN) at rkm 51.1, in the North Fork Noyo River above the confluence of Hayworth Creek (NFN) at rkm 43.6, in the Noyo River at Northspur below the North Fork confluence (NRS) at rkm 37.6, in Olds Creek (OLD) at rkm 49.5, and in Redwood Creek (RWC) at rkm 51.1 (Fig. 2). Two traps were operated by CDFG (M. Knechtle, pers. comm.) in the South Fork Noyo River during 2001. One trap was located in the South Fork above the ECS the other was located in the North Fork South Fork (Fig. 2).

Resident Population Estimates

To examine differences in fish size/age and condition between trap catches and instream residents and to determine delayed emigration above and below traps, estimate survival, and estimate stream resident populations in 100 m sections of stream above and below each trap (except MSH) were electro-fished periodically during spring and early-summer 2001. Each 100 m section was located 100 m above or below each trap. The downstream section for the HWC/NFN site was a 100 m section in the North Fork below the confluence of the two streams. The downstream section of the MSN/RWC site was a 100 m section in the Noyo River below the confluence of these two streams. The upstream section for NRS was in the mainstem Noyo River above the NFN confluence. Two downstream sections were shocked below the OLD trap site, one in OLD and one in the Noyo River below the OLD confluence.

Methods and Materials

Fyke Trapping

In general, the methods employed by Gallagher (2000) were followed for this study. The opening of a 3.05 x 1.22 x 12.19 m fyke net (5 mm mesh) was set in the head of a riffle with the downstream end connected to a 3.05 m long 20 cm diameter pipe with a 3 mm mesh live car set in the riffle tail. Each trap had one to four 2.44 x 1.22 m (6 mm mesh) weir panels set diagonally into the mouth of the net to funnel fish into the traps. Wood panels and boulder walls were placed along the weir panels during periods of low flow to increase water velocity into the traps. Debris screens were set above the opening of each trap and a 0.5 to 1 m section of stream on one side of the trap weir was left unblocked to allow adult fish to bypass the traps.

Traps were set in HWC, MSH, MSN, NFN, and NRS on 28 March 2001. The NRS trap was also operated from 16 November 2000 through 8 February 2001 to examine early season movement. High stream flows increased the lobor needed to operate this trap through the winter, so it was removed until 28 March. The OLD and RWC traps were installed on 15 April 2001. All traps were checked daily through 28 June 2001. Trap checking procedures followed procedures outlined by Barrineau and Gallagher (2001). All steelhead and coho > 50 mm fork length were measured to the nearest mm, weighed to the nearest 0.1 g, marked with a site and week specific brand following the methods of Everest and Edmundson (1967) and Gallagher (1999) and released upstream of the traps. Thirty fish of each species and size/age class were measured all others were counted each day. All other species captured were measured to total length and released below the traps. All steelhead and coho >50 mm were examined for marks each day. Those without marks were marked and released a minimum of 100 m above the traps. Recaptured fish were measured, weighed and released a minimum of 100 m below the traps. Measured and branded fish were anesthetized using alka-seltzer (Ross unpublished). Scale and tissue samples were taken from a small sample of steelhead each day. Mortalities were recorded by species and size class each day. Water and air temperatures and general weather information were recorded daily for each trap.

Stream Flow and Temperature

Water temperature was measured daily while processing fish at each trap site. Continuous digital temperature recorders were placed at the trap sites on 1 November 2000. Temperature recorders were set to record water temperature every hour.

Stage gauges were attached to fence posts and placed in areas of relatively level stream flow at all trap sites during 2000 (Gallagher 2000). Gauge heights were recorded for all trap sites except MSH while checking the traps each day. Stream flows were determined from stage gauge heights and the rating curves developed by Gallagher (2000). Stream flow for the MSH trap was acquired from US Geological Survey stream gauge (# 11468500) located below Hayshed Gulch on the main stem Noyo River.

Resident Population Field Sampling

To examine differences in fish size/age and condition between trap catches and instream residents and determine delayed emigration above and below traps, estimate survival, and estimate stream resident populations in 100 m sections above and below each trap were electro-fished periodically during spring and summer 2001. In general, one person operated the electro-fisher (Smith-Root model 12-B set at I-5 and 300 volts) accompanied by two persons with dip nets. All crew members wore polarized glasses to help increase detection of fish. All steelhead and coho > 50 mm fork length were measured to the nearest mm, weighed to the nearest 0.1 g, marked with a site and date specific freeze brand, and released as near as possible to the place where they had been captured. All fish <50 mm were counted. Fish were continuously monitored during and after capture to detect signs of stress. Water temperature in holding buckets was monitored and replaced often during warm days or when catches were high. Sampling occurred bi-weekly beginning in late-April.

Data Analysis

To estimate steelhead populations, capture probabilities, and timing for each trap, I totaled all captures and recaptures by week and size/age class to create capture-recapture matrices for input to Darr (E. Bjorkstedt, Pers. Comm.). These matrices were than ran in Darr to produce population estimates and capture probabilities for steelhead 51-70 mm (YOY), 71-120 mm (Y+), and > 120 mm (Y++). Age/size classes were developed by examining fork length frequencies from Gallagher (2000), examination of size age relationships from Shapovalow and Taft (1954), and discussion with local fish biologists. Steelhead < 71 mm captured before fry were first observed in the spring were assumed to be Y+. Coho salmon were treated as Y+ until YOY were found > 50 mm in spring, after which fork length frequencies were used to separate year classes. I calculated weekly totals of steelhead and coho <50 mm from the daily catch data. I also totaled all other species caught by week. Total species and numbers observed throughout the trapping period were used to calculate species diversity for each trap. Species diversity was calculated as H’ using the Brillouin index because trapping is a selective and nonrandom collection method (Brower and Zar 1984).

To estimate steelhead YOY populations fish < 70 mm captured in late-spring were assumed to be young of the year. The YOY trap population estimates were combined with the total count of steelhead < 50 mm to estimate the total YOY population for each trap. In cases (RWC and OLD) where too few YOY, Y+, or Y++ steelhead were marked and recaptured to make separate population estimates I used the percentage of YOY < 70 mm plus the total YOY count to get a total population estimate. Confidence intervals for steelhead < 50 mm were estimated by multiplying the proportion of the confidence estimate divided by the population estimate for YOY >50mm from the Darr analysis. The total population above NRS was assumed to be the sum of all traps (all traps combined).

A similar approach was used to calculate populations for each species and size/class using a two-trap method for NRS and MSH. All fish captured and marked at the five traps above NRS were treated as the marked and released portion in the Darr input matrix and all marked fish captured and recaptured at NRS were treated as captured and recaptured in the matrix. These matrices were run in Darr to estimate parameters as above. The total population moving past the traps above NRS was calculated by summing the estimates from the five traps above NRS as it was assumed that the NRS population estimate represents fish moving past NRS. All fish captured and marked at the six traps above MSH were treated as the marked and released portion in the Darr input matrix and all marked fish captured and recaptured at MSH were treated as captured and recaptured in this matrix. These matrices were run in Darr to estimate parameters as above.

Relationships between average weekly temperature and stream flow and weekly capture probabilities were examined using Spearman rank correlation because standard Kurtosis values were > 0.05. Relationships between daily trap catches and daily stream flow and temperature were examined using Spearman rank correlation.

Differences between trap and resident fork lengths were compared using Mann-Whitney U-tests due to high standard kurtosis values. Differences between the one and two trap population estimation methods were examined with t-tests.

Steelhead population and survival estimates in electro-fishing reaches were computed using the Jolly-Seber method in the program Jolly (Krebs 1989). In cases where enough steelhead of each size class were marked and recaptured, population estimates were made separately for YOY (51-70 mm), Y + steelhead (71-120 mm), and Y++ (>120 mm). In cases where to few steelhead of one age class (based on fork length size at sample time) were marked and recaptured, total population estimates were made and multiplied by the percentage of fish in each size class. This was added to counts of steelhead < 50 mm to estimate total YOY, Y+, and Y++ populations in each 100 m reach. The procedure described above was used to estimate 95% confidence intervals for YOY steelhead < 50 mm. All electro-fishing reaches were measured and population estimates for each section were divided by the actual length of stream sampled to produce estimates of the number of fish/m. Stream resident populations were estimated by multiplying the number of fish/m for each age class by the total length of stream in which redds were observed

(Gallagher 2001). Population estimates in the Noyo River between OLD and NRS used the average density of the below OLD and above NRS multiplied by the stream distance represented by the two.

Young of the Year Population Estimation and Prediction

YOY populations were estimated for each stream reach by summing the individual trap and stream reach population estimates. To estimate the total population, trap estimates and stream resident population estimates by stream reach were summed. The total YOY population was the sum of the individual trap and stream combinations. To estimate the total population with the two-trap method, the trap population estimates and the stream resident estimates were summed. The below NRS population estimate was not included in this analysis. Bootstrap confidence levels were the sum of the individual confidence levels. Y+ populations were estimated as above.

The estimated number of adult females in each stream reach and the average size of a female steelhead during 2001estimated by Gallagher (2001) was used to estimate the number of YOY in each reach. A length/fecundity relationship developed by Shapovalov and Taft (1954) was used to estimate the number of eggs per female and the total expected number of eggs in each stream reach. The 95% confidence level of 9.67 eggs/cm of female size developed by Gallagher (2000) was used to estimate the 95% confidence level for total egg production in each stream. An estimate of 80% survival from egg to fry (20% mortality in a non-silted stream) from Shapovalov and Taft (1954) was used to calculate the number of fry expected in each stream reach. The estimated probability of survival from Jolly-Seber estimates based the electro-fishing this season (Table 1) was used to estimate the number of YOY present in late-June. In two cases (OLD, RWC) the number of marked and recaptured fish was to small to make relaible estimates of survival, so the average survival (0.75) from all other sites was used.

The Y+ population estimates from electro-fishing and trapping was combined to estimate the total number of steelhead present above NRS during 2001. These data were compared to YOY estimates from spring 2000 (Gallagher 2000) to examine over-winter survival.

Predicted and estimated populations were compared using t-tests or Mann-Whitney U-tests when standard kurtosis p-values were >0.05. Statistical significance was accepted at the 0.05 probability level.

RESULTS

Fyke Trapping-Steelhead

The total number of steelhead captured by size/class for each trap, the total in all traps, and the total for the two-trap estimates are shown in Table 2. Darr input matrices summarizing weekly captures are shown in Appendix A. Population estimates and standard deviations (SD) for steelhead 51-70 mm, 71-120 mm, > 120 mm and all > 50 mm are shown in Table 2. Larger streams or streams with larger drainage areas had higher estimated populations. Standard deviations ranged from 4.3 to 73.8% of the estimated population for steelhead between 51-70 mm and averaged 43.0%. The average SD for steelhead between 71-120 mm was 37.1% of the estimated population and ranged from 7.5 to 68.0%. Standard deviations ranged from 53.2 to 97.0% of the estimated population for steelhead > 120 mm and averaged 74.6%. For all steelhead > 50 mm the average SD was 36.1 % and ranged from 19.4 to 66.2%. Generally, traps and size classes with higher numbers of recaptures had smaller standard deviations. The NRS site (Fig. 2) is below five trap sites and captured fish were produced above and below these sites. Capture probability for steelhead > 50 mm ranged from 0.01 to 0.27 and averaged 0.13 (Table 2). Capture probabilities for steelhead 51-70 mm ranged from 0.0 to 0.14 with an average of 0.08. Capture probabilities for steelhead between 71-120 mm ranged from 0.01 to 0.32 and averaged 0.13. Capture probability for steelhead > 120 mm ranged from 0.06 to 0.18 and averaged 0.09 (Table 2).

The different size/age classes were treated as individual samples and comparisons the one and two trap estimates were not significantly different (Fig. 3, Table 3, ANOVA $f = 0.11$, $p = 0.89$, $n = 15$). However, the power of this test was low ($\alpha = 0.05$). Population estimates for the two-trap method were higher for steelhead between 51-70 and 71-120 mm, while estimates for steelhead > 120 mm were not different (Fig. 3, Table 2). The average individual trap capture probabilities for each size class were higher than those from the two-trap method (Table 2). Standard deviations from the two-trap method were lower for fish between 51-70 mm, > 120 mm, and all fish > 50 estimates than for individual traps combined. A total of 84,310 (SD = 59,831) YOY, 33773 (SD = 12,623) Y+, and 1,668 (SD = 972) Y++ steelhead were estimated in the Noyo River by totaling all traps. A total of 922,454 (SD = 44,997) YOY, 22,546 (SD CI = 59,831) Y+, and 1428 (SD CI = 1373) Y++ steelhead were estimated to have passed the NRS trap in the Noyo River by the two-trap method (Fig. 3, Table 2). A total of 1,357,052 (SD = 135,493) YOY, 76,386 (SD = 20,783) Y+, and 1045 (SD = 556) Y++ steelhead were estimated to pass the MHS trap in the Noyo River by the two-trap method (Fig. 3, Table 2).

Weekly trap captures, population estimates, and capture probabilities for marked size steelhead YOY steelhead for individual traps are shown in Figs. 4-7. Weekly capture probabilities ranged from 0.01 to 0.38 for YOY steelhead. Weekly trap captures, population estimates, and capture probabilities for Y+ steelhead for individual traps are shown in Fig. 5 and ranged from 0.0 to 0.51. Weekly trap captures, population estimates, and capture probabilities for Y++ steelhead for individual traps are shown in Fig. 6 and ranged from 0.04 to 0.19. Weekly trap captures, population estimates, and capture probability from the two-trap estimation for marked size YOY, Y+, and Y++ steelhead are shown in Fig. 7. Weekly captures and population estimates were generally higher for Y+ and Y++ steelhead early in the year while marked YOY population estimates were higher later in the season. The percentage of each size/age class captured at each trap is shown by week in Fig. 8. Fry (< 50 mm) were observed after week 14 (1 April 2001). Y+ and Y++ steelhead were generally captured earlier in the season while fry and larger YOY were captured later in the year (Fig. 8). Most Y++ fish appear to move between December and mid-March (Fig. 8e). Movement into the estuary by different age/size steelhead follows the pattern observed at upstream traps with older/larger fish moving earlier than smaller/younger fish (Fig. 8b). Forty one percent of the Y+ and Y++ steelhead captured at NRS this season moved between November and February. It is unknown how many steelhead moved between week 7 and 13, 2001

Fyke Trapping-Coho Salmon

The total number of coho salmon captured by size/age class for each trap, the total in all traps, and the total for the two-trap estimates are shown in Table 3. Darr input matrices summarizing weekly captures are shown in Appendix A. Population estimates and 95 % confidence intervals for coho YOY (> 50 and 51-80 mm) and Y+ (> 80 mm) are shown in Table 3. Hayworth Creek and the MSN had the highest individual coho population estimates (Table 4). Capture probabilities for coho YOY ranged from 0.03 to 0.22 (average = 0.12) and were not calculated for most traps due to low numbers of marked-recoveries. Capture probabilities for coho Y+ ranged from 0.06 to 0.38 and averaged 0.18. Capture probability was not significantly different between coho and steelhead > 50 mm (Tables 2-3, $t = -0.76$, $p = 0.46$). However, the power of this test was low ($\alpha = 0.05$). The total YOY coho population was estimated as 3572 (SD = 2210) by combining individual trap estimates and was not calculated for the two-trap method (Table 3, Fig. 9). The total Y+ coho population was estimated as 20,760 (SD = 17531) (Table 3, Fig. 9). The two-trap methods at NRS estimated that 630 (SD = 89) Y+ coho salmon moved past this trap. The two-trap methods at MSH estimated that 2232 (SD = 387) Y+ coho salmon moved past this trap. Contrary to steelhead estimates, the summed trap estimates were higher than the two-trap estimates for Y+ coho salmon (Table 3, Fig. 9). The summed trap estimate was higher than the two-trap estimate at NRS but lower than the two-trap estimate at MSH. A total of between 19,752 (SD = 4323) and 26,765 (SD = 5229) coho > 50 mm were estimated to have moved past the MSH trap and into the Noyo River estuary during spring and early summer 2001. A total of 25,029 (SD = 6121) coho salmon were estimated in the Noyo River by combining all trap estimates. Treating the size/age classes as individual samples there was no significant difference in the estimates from the two-trap method at MSH and the total of all traps ($t = 5.0$, $p = 0.699$, n = 2:2), although the sample size was small.

Weekly trap captures, population estimates, capture probability for coho > 50 mm for each trap are shown in Fig. 10. Weekly capture probabilities ranged from 0.08 to 0.55 for coho salmon (Fig. 10). Weekly trap captures, population estimates, capture probability from two-trap estimates for coho > 50 mm are shown in Fig. 11. Weekly trap capture probabilities from the two-trap estimates ranged from 0.04 to 0.11.

The percentage of YOY (< 50 and 51-80 mm) and Y+ (>80 mm) coho salmon captured for each trap are shown by week in Fig. 12. Fry were first observed during week 14. YOY > 50 mm were first observed during week 16. The Y+ sized coho salmon moved between week 50, 2000 and week 22, 2001. Only about 3% of the Y+ coho salmon moved past the NRS trap between week 50, 2000 and week 6, 2001 (Fig. 12). It is unknown how many coho salmon moved between week 7 and 13, 2001.

Fyke Trapping-Chinook Salmon

A total of 5,342 (SD = 1440) YOY chinook salmon > 50 mm moved past the MSH trap between week 17 and 26, 2001. Capture probability averaged 0.16 and ranged from 0.03 to 0.29. A total of 475 chinook salmon < 50 mm moved past the MSH trap between week 17 and 26, 2001. YOY chinook salmon captures peaked between weeks 20 and 23, 2001. Chinook salmon were not captured at any other trap in the Noyo River during 2001. Chinook salmon fork lengths averaged 0.54 mm (SE = 0.22) and ranged from 31 to 80 mm during the trapping period. Larger fish were captured later in the season. 2001 was the first year YOY chinook salmon were found in the Noyo River.

Fyke Trapping-Other Species

Nine species of fish were captured in fyke traps in the Noyo River during 2001 (Table 4). Pacific lamprey > 250 mm were considered adults and were captured between week 13 and 25. A total of 195 Pacific lamprey adults were captured in traps on the Noyo River during 2001. Eighty-two percent were captured at MSH, 11% at NRS, 5% at MSN, and 2% at HAY. No Pacific lamprey adults were captured at NFN, OLD, or RWC. Pacific lamprey YOY were captured at all traps except OLD. No adult lamprey, sculpin or three-spine stickleback were captured at the NFN trap (Table 4). Pacific lamprey < 120 mm, assumed to be ammocoetes, were captured throughout the trapping period in the NFN trap. No adult or juvenile lamprey were captured at the OLD trap (Table 4) suggesting lamprey do not inhabit this creek. One California roach and one shiner surfperch were captured at the MSH. No California roach or surfperch were captured at any other traps or during extensive electro-fishing this year. Most sculpin were captured lower in the river at MSH. Two species of frogs, one of salamander, three of newts, one snake, and one of turtle were captured throughout the trapping season. Species diversity at each trap site ranged from 0.12 to 0.43 and was highest for the MSN trap (Table 4).

Recaptures-Steelhead

On average 59.4 % of steelhead captured and marked in the traps were recaptured in the traps within seven days (Table 5). Of the fish captured and marked in the traps and recaptured during electro-fishing, 17.2% were captured more than 84 days after initial capture (Table 5). Four fish marked during trapping were re-captured above the traps during electro-fishing more than 147 days after being marked. One fish marked at a trap was re-captured during electro-fishing >140 days after being marked and 50% of fish marked at traps were recaptured < 21 days after being marked (Table 5). One steelhead marked at the RWC trap was re-captured 1.6 km downstream in the OLD trap six weeks after being marked. One steelhead marked in the OLD trap was recaptured five weeks later during electro-fishing above NRS. On average 90.3% of steelhead captured and marked at the five traps above NRS were recaptured within 14 days and 9.7% were recaptured within 35 days at NRS (Table 6). This suggests travel time between the upper traps and NRS was between < 7 and 35 days, a distance of 11.9 to 14.5 km. Only 17 out of 486 steelhead marked and released at the six upstream traps were recaptured at MSH (Table 5 and 7). Of these 45.2% were recaptured within 14 days. One steelhead was recaptured after 42 days at MSH suggesting travel time for 31.3 km between the upstream traps and the lower river ranged from < 7 to 42 days (Table 7). Steelhead captured and marked during electro-fishing above the traps were recaptured above the traps during electro-fishing between < 7 and > 105 days after being marked (Table 8). Steelhead captured and marked during electro-fishing below the traps were recaptured below the traps during electro-fishing between < 7 and > 105 days post marking (Table 8).

Recaptures-Coho Salmon

On average 76.2% of coho salmon captured and marked in the traps were recaptured in the traps within seven days (Table 9). On average 95.0% of coho salmon captured and marked in the traps were recaptured in the traps within 14 days. Only two coho salmon captured and marked in the traps were recaptured after 35 days. On average 95% of the coho salmon marked at the five traps above NRS were recaptured within 14 days at NRS (Table 10). One coho salmon took 28 days to travel from MSN to NRS, a distance of 14.2 km. This suggests that travel time between the five traps above NRS and NRS was between <7 and 28 days. On average, 45.3% of the coho salmon marked at the six upstream traps were recaptured within 14 days at MSH (Table 11). One coho salmon was recaptured at MSH after 49 days suggesting travel time between the upstream traps and MSH was between < 7 and 49 days. Coho salmon captured and marked during electro-fishing above the traps were recaptured above the traps during electro-fishing between 14 and 56 days after being marked (Table 8). Coho salmon captured and marked during electro-fishing below the traps were recaptured below the traps during electro-fishing between 7 and 21 days post marking (Table 8). One YOY coho salmon captured and marked at NRS was recaptured 6 km upstream after 5 weeks in the OLD trap.

Known trap mortality for steelhead < 50 mm ranged from 0.64 to 2.48 % and averaged 1.20%. Trap mortality for steelhead 51-70 mm ranged from 0 to 41.1% and averaged 11.1%. Trap mortality for steelhead 71-120 mm ranged from 0 to 20.1% and averaged 4.18 %. Trap mortality for steelhead >120 mm ranged from 0 to 16.6% and averaged 3.3%. No trap caught and branded fish were found dead in the traps. Trap mortality for coho salmon < 50 mm ranged from 0 to 14.77 % and averaged 3.06%. Trap mortality for coho salmon 51-80 mm ranged from 0 to 5.47 % and averaged 1.64%. Trap mortality for coho salmon >80 mm ranged from 0 to 4.76 % and averaged 0.95%. The number of trap mortalities generally increased as total captures and stream flows increased. The high mortality of 41.1% of the 51-70 mm steelhead and 14.8% for coho salmon < 50 mm occurred at the MSH trap during two high flow events. The presence of adult Pacific lamprey also increased mortality.

Survival Estimates

The probability of survival for steelhead from one marking period to the next from Jolly-Seber mark-recapture electro-fishing in the Noyo River during 2001 is shown in Table 1. Survival for marked sized YOY steelhead averaged 0.75 and ranged from 0.63 to 0.84 for stream reaches for which recaptures were sufficient to produce population estimates. Probability of survival estimates for Y+ steelhead ranged from 0.29 to 0.75 and averaged 0.55. Probability of survival estimates for Y++ steelhead ranged from 0.19 to > 1.0 and averaged 0.81. It was only possible to calculate probability of survival for coho salmon for five of the eight segments for all captures combined due to the low number of recaptures. Coho salmon probability of survival averaged 0.61 and ranged from 0.07 to 4.96.

Stream Flow and Temperature

Daily average stream discharge and temperature for seven fyke net trap sites are shown in Fig. 13. Water temperature at HWC, MSN, NFN, NRS, RWC, and OLD ranged from 4-18 °C (Fig. 13.). At the MSH site water temperature ranged from 9-21 °C. Water temperature at the MSN site ranged from 8-20 °C.

Total steelhead daily catches at each trap site were significantly correlated with daily stream flow at MSH and RWC (Table 12). The pattern for steelhead < 50 mm was the same (Table 12). Steelhead catch for fish between 51-70 mm were significantly positively correlated with discharge at MSH and significantly negatively correlated at NRS (Table 12). Steelhead Y+ captures were significantly positively correlated with stream flow at five of seven sites (Table 12). Steelhead Y++ captures were significantly positively correlated with stream flow at two of seven sites (Table 12). Daily total steelhead captures were significantly correlated with stream temperature at MSH and RWC. The pattern for steelhead < 50 mm was the same (Table 12). Steelhead catch for fish between 51-70 mm were significantly positively correlated with temperature at five of seven sites. Steelhead Y+ captures were significantly negatively correlated with stream temperature at four of seven sites (Table 5). Steelhead Y++ captures were significantly negatively correlated with stream flow at three of seven sites (Table 12).

Total coho daily captures were significantly correlated with stream flow at three of seven sites (Table 13). Coho salmon YOY and Y+ daily captures were significantly correlated with stream flow at three of seven sites. Total coho daily captures were significantly correlated with stream temperature at three of seven sites (Table 13). Coho salmon YOY daily captures were significantly correlated with stream temperature only at one site. Coho salmon Y+ daily captures were significantly correlated with stream temperature only at one site (Table 13).

Weekly steelhead and coho trap capture probabilities and weekly average stream discharge and weekly average water temperature correlation coefficients and p-values are shown in Table 14. In three of five cases stream discharges were significantly positively correlated with steelhead > 50 mm capture probabilities. In four of five cases water temperatures were significantly negatively correlated with steelhead > 50 mm capture probabilities. In two of five cases stream discharges were significantly positively correlated with steelhead 51-70 mm (YOY) capture probabilities. In two of five cases water temperatures were significantly negatively correlated with steelhead 51-70 mm capture probabilities. In four of five cases stream discharges were significantly positively correlated with steelhead Y+ (71-120 mm) capture probabilities. In four of five cases water temperatures were significantly negatively correlated with steelhead 71-120 mm capture probabilities. Steelhead > 120 mm (Y++) capture weekly capture and capture probability were not related for the two sites where recaptures were sufficient to calculate these values. Coho salmon weekly captures and capture probabilities were significantly positively correlated with stream discharge and significantly negatively correlated with water temperature for two of five trap sites (Table 14).

Resident Population Estimates

The estimated number of steelhead/m and 95% confidence levels for 100 m stream reaches electro-fished in the Noyo River during 2001 and the length of stream these segments represent are shown in Table 15. Steelhead < 50 mm were not marked so these numbers are based on total catch without confidence bounds. Steelhead 51-70 mm (YOY) densities averaged 1.68/m and ranged from 0.0 to 6.59/m. Steelhead Y+ densities averaged 0.36/m and ranged from 0.11 to 0.95/m (Table 15). Steelhead Y++ densities averaged 0.15/m and ranged from 0.01 to 0.40/m. Total resident populations were expanded for the entire stream (Fig. 14). Dividing the resident population estimate by the trap and resident summation gave an estimate of the proportion of YOY remaining in the stream above the traps. A similar procedure was used to estimate the percentage of Y+ and Y++ steelhead remaining in the stream above the traps. The average percent YOY residing as of 1 July 2001 was 49.4% and ranged from 23.2 to 79.5 % (n = 5, S.E. =9.7%). The highest percent of YOY rearing was in HWC while the lowest was at MSN. Thus, on average, 50.6% of the YOY produced above the traps moved below the traps by 1 July 2001. The average percent Y+ steelhead residing was 60.4 (n = 6, S.E. = 10.2%) and ranged from 29.4 to 99.0%. The average percent Y++ steelhead residing was 72.5 (n = 6, S.E. = 15.0%) and ranged from 1.0 to 100%. Resident population estimates for the Noyo River below NRS and the South Fork Noyo River were not made and therefore it is unknown what percentage of steelhead reared between NRS and MSH.

The estimated number of coho salmon/m and 95% confidence levels for 100 m stream reaches electro-fished in the Noyo River during 2001 and the length of stream these segments represent are shown in Table 16. Coho salmon < 50 mm were not marked so these numbers are based on total catch without confidence bounds. Coho salmon YOY densities averaged 0.12/m and ranged from 0.0 to 0.33/m. Coho salmon Y+ densities were not estimated due to low numbers of marked and recaptured fish. Total coho salmon resident populations were expanded for the entire stream (Fig. 15). All Y+ coho salmon were assumed to have left the river above NRS by 1 July 2001. The percentage of YOY coho salmon rearing averaged 87.9% and ranged from 59.9 to 99.9%.

Steelhead fork lengths were significantly different between trap-captured fish and fish captured electro-fishing above the traps in all but two cases for the weeks when electro-fishing was conducted (Table 17). Steelhead were significantly larger in the streams than in the traps. Coho salmon fork lengths were significantly different between trap-captured fish and fish captured electro-fishing above the traps only at one site early in the season (Table 18).

Young of the Year Population Estimation and Prediction

The estimated and predicted YOY steelhead populations for the Noyo River by stream reach and the total above NRS are shown in Fig. 16. Treating the stream reaches as samples there was no significant difference between estimated and predicted YOY steelhead populations in the Noyo River during 2001 (Fig. 16: $T = 70$, $n = 8:8$, $p = 0.89$). Removing the total trap estimated and predicted populations (all traps combined and the two-trap method) from the analysis there was no significant difference between the YOY population estimates ($T = -0.18$, $n = 6:6$, $p = 0.86$). However, the power of this test was low ($\alpha = 0.05$).

By week 26 the predicted number of fry surviving from the production of one 76 cm female was estimated to be 7240 (95% CI = 587). The difference between predicted and estimated YOY were within the predicted production of one average female for MSN, OLD, and RWC. The difference between predicted and estimated YOY were within the predicted production of two females for HWC and NRS. The difference between predicted and estimated YOY were within the predicted production of three females for NFN. The sum of all traps and the two trap predicted versus estimated YOY were within the predicted production of five and 122 females, respectively.

The YOY trap population estimates for the South Fork and the North Fork South Fork Noyo River (Knectle, pers. com.) and the average estimated percent residency from the upper Noyo River during 2000 was used to estimate the number of YOY steelhead above these traps. The predicted number of YOY for the South Fork and the North Fork South Fork Noyo River during 2001 was calculated from estimates of adult female steelhead (Gallagher 2001), the average survival estimated for the upper Noyo River, and the fecundity regression and percentage survival from egg to fry from Shapovalov and Taft (1954). The YOY steelhead population estimated for the South Fork and the North Fork South Fork was 1,828 (SD = 834) and 3,437 (SD = 2,401), respectively. The YOY steelhead population predicted for the South Fork and the North Fork South Fork was 16,238 (SD = 1,565) and 20,560 (SD = 2,167), respectively. The YOY steelhead population below the trap sites on the South Fork Noyo River which included Kass Creek was predicted to be 19,722 (SD = 1,847). The South Fork estimated versus predicted YOY steelhead populations differed by the predicted production of nine females. The North Fork South Fork estimated versus predicted YOY steelhead population estimate differed by the predicted production of 12 females.

The number of YOY steelhead in the Noyo River below North Spur including Duffy and Hayshed gulches during 2001 was predicted to be 42,225 (SD = 3,855). It was estimated that 20,804 (SD = 1904) of these fish were residents in this section as of 1 July 2001. The number of YOY steelhead produced and residing in the Little North Fork Noyo River as of 1 July 2001 was estimated at 5,145 (SD = 482) and 2,542 (SD = 239), respectively. Totaling all estimates the total YOY steelhead population in the Noyo River as of 1 July 2001 was predicted to be 226,344 (SD = 20,029).

2000 and 2001Population Estimates

The 2000 rearing YOY population estimates from Gallagher (2000) and the 2001 Y+ population estimates in the upper Noyo River are shown in Fig. 17. The estimated survival from YOY to Y+ is shown in Table 1. Average survival from YOY to Y+ was 0.38 and ranged from 0.01 to 1.0. The estimated survival from the Jolly-Seber method for Y+ averaged 0.55, ranged from 0.29 to 0.74. Jolly-Seber survival estimates for Y+ were higher than those estimated from changes in YOY 2000 to Y+ 2001 population estimates, an average of –0.14.

Steelhead YOY and Y+ trap population estimates for 2000 and 2001 are shown in Fig. 18. The YOY and Y+ population estimates appear higher in 2000 than in 2001 and this trend is similar for all traps operated in the Noyo River during these two years. The individual trap estimates and the YOY 2000 and 2001 population estimates were not significantly different ($t = 1.39$, $p = 0.18$, $n = 8$). However, the power of this test was low ($\alpha = 0.14$). The individual trap estimates and the 2000 and 2001 Y+ population estimates were not significantly different ($t = 0.97$, $p = 0.35$, $n = 8$). However, the power of this test was also low ($\alpha = 0.05$). The proportion of YOY and Y+ in the traps both years was similar at 97 and 3%, respectively.

Steelhead YOY and Y+ rearing population estimates for 2000 and 2001 are shown in Fig. 19. One half of the rearing YOY population estimates appear higher in 2000 than in 2001, but were not significantly different ($t = -0.45$, $p = 0.66$, $n = 8$). Six of the sites show Y+ population estimates to be higher in 2000 than in 2001, yet the difference was not significant ($t = 1.64$, $p = 0.12$, $n = 8$). The power of these tests were low ($\alpha = 0.05$ and 0.22, respectively).

Discussion

Fyke Trapping

Steelhead trapping results in coastal Mendocino County are variable within and among rivers and between years in streams studied by Harris (Harris and Hendrix 2000). There are no clear trends in Y+ steelhead captures over 13 years of migration trapping for Caspar Creek and Little River. Similarly, there are no apparent trends in three years of trapping for the South Fork and North Fork South Fork Noyo, Hare Creek, and Wages Creek (Harris and Hendrix 2000). Maahs (1997) compared results of trapping of Y+ steelhead in three tributaries to the South Fork Ten Mile River between 1995, 1996, and 1997. He found two of three streams had fewer out migrants in 1997, while the third stream was relatively constant. Maahs (1995, 1996, 1997) used mark-recapture to estimate trap efficiencies in order to expand trap counts for days in which traps were not in operation. The apparent similarity in the YOY and Y+ steelhead captures trends for all traps in the Noyo River over two years and the lack of trends for these and other traps in earlier years could be due to the fact that prior to 2000 all trap data was reported as total capture without population estimates and confidence bounds. It could also be due to flow conditions where both 2000 and 2001 annual mean stream flows were < 4.2 m^3/s

compared to the 49-year average of 6.01 m^3/s (min = 1.17, max = 14.2 m^3/s). However, flows alone do not explain this observation as during 2000 all captures and capture probabilities were significantly associated with stream flow while during 2001 this was only partially the case.

Average capture probability for YOY steelhead during 2001 was within the range estimated during 2000 (Gallagher 2000). Average capture probability for Y+ steelhead during 2001 was within the range estimated during 2000 (Gallagher 2000). Maahs (1995) had a recapture rate of 74% for year plus steelhead trapping in the Little North Fork Noyo River that he attributed to stream size and trap design. Trapping methods and trap design were similar to that described by Maahs (1995) in the Noyo during 2001. During 1996, trap efficiencies were approximately 36% and during 1997 were about 42% for streams monitored by Maahs (1996, 1997). Harris and Hendrix (2000) report year plus steelhead capture probabilities for the North Fork South Fork and the South Fork Noyo River at 30 and 18%, respectively. Capture probabilities for Y+ steelhead in the South Fork Noyo River during 2001 was 0.05 (M. Knectle, pers. comm.). Trap capture probabilities for the upper Noyo River during 2001 were generally lower than those reported recently for other local streams. Ward and Slaney (1988) report box trap efficiencies of 90% for Y+ steelhead on the Keogh River in British Columbia. Thedinga et al (1994) found that screw trap efficiencies varied among salmonid species and was lowest for steelhead at 3%. Fyke net trap efficiencies in the Noyo during 2001 were better than those reported for screw traps and lower than box traps and other local fyke traps. Trap capture probability changed through the season, for steelhead > 50 mm at NRS it was higher earlier in the year (Nov.-Feb.) when flows were higher (Table 2).

Steelhead population estimates from fyke traps were lower in 2001 than in 2000. However, they were not significantly different. Steelhead population estimates from traps in each stream in the Noyo River during 2001 were larger for larger streams. Confidence levels ranged between 4.1 and 100% of the population estimates. Generally, those streams with low capture probabilities had larger confidence intervals that probably resulted from poor trap placement and/or low flows. Dempson and Stansbury (1991) used a two-trap approach to estimate Atlantic salmon smolt populations in Newfoundland. Their reported confidence limits were within 8% of the population estimates. The two trap approach on the Noyo River during 2001 had lower estimated capture probabilities and tighter confidence intervals for Y+ steelhead, while YOY and Y++ steelhead and the total marked population confidence intervals were larger with the two trap method than that calculated by summing the results from individual traps. This result is similar to trapping results in the Noyo River during 2000 (Gallagher 2000). The differences in population estimates from summing all individual traps and the two-trap method were not significantly different. The confidence limits for Y+ steelhead were 33.6 at NRS and 27.2 % at MSH of the population estimates using the two trap method as compared to 37.4% by totaling all the trap estimates. The NRS trap population estimate is much lower than the two-trap population estimate. The MSH Y+ trap population estimates and confidence bounds were much lower than the two-trap estimate, this may be a result of low numbers of recaptures in the two-trap method. The MSH YOY and Y++ trap population estimates and confidence bounds were similar to those from the two-trap estimate. The one and two-trap population estimates were not significantly different. The percentage of cohort size classes and timing of capture at MSH was similar to other traps in the Noyo River during 2001 (Fig. 8). Trends in YOY and Y+ population estimates were similar in 2000 and 2001 at the six upstream traps. Therefore the use of one trap at MSH may be sufficient to monitor steelhead trends over time. This would reduce field effort considerably, but would not allow following cohorts and estimation of survival over time in individual tributaries.

Coho salmon > 50 mm capture probabilities were not significantly different from those of steelhead > 50 mm. Coho salmon population estimates using the sum of all traps and the two-trap method at MSH were similar. Harris and Hendrix (2000) report capture probabilities for coho in the South Fork and North Fork South Fork of 0.27 and 0.38, respectively. Coho capture probabilities were within this range in the upper Noyo during 2001 and are similar to those reported by Gallagher (2000). Coho salmon capture probabilities were similar to those from the South Fork Noyo River during 2001 (M. Knectle, pers. comm.). Maahs (1997) reports trap efficiency for coho in the Ten Mile River to range from 24 to 58%. Maahs (1995) had recapture rates of 90% for coho in the Little North Fork Noyo River. Manning (1998) reports trap capture efficiencies for coho in the Little North Fork Noyo River of 77% for 1995 and 91% for 1996. Coho capture probabilities were generally lower than during 2000. This could be due to lower flows in 2001 or because coho were not consistently marked during 2000.

Coho population estimates exhibit a similar pattern to steelhead where larger streams have larger populations. Coho salmon population estimates from trapping were higher than during 2000 (Gallagher 2000) due to fish being marked and released throughout the trapping period during 2001. However, the difference was not significant ($t = 0.45$, $p = 0.67$, $n = 8$), and the power of this test was low ($\alpha = 0.05$). Coho salmon population estimates in the South Fork Noyo River in 2000 (Harris and Hendrix 2000) were lower than during 2001 (M. Knectle, Pers. Comm.). However, the difference was not significant ($t = 6$, $p = 0.67$). Contrary to 2000, coho salmon were found in Olds Creek. However, no coho salmon redds were identified in Olds Creek during 2001 (Gallagher 2001). It may be that all coho salmon found in Olds Creek during 2001 moved into the 500 m reach below the old mill dam from the main stem Noyo River to rear.

Time Between Capture and Recapture

The time between marking and recapture of steelhead for individual traps ranged from < 7 to > 70 days. Steelhead travel time between the upstream traps and the NRS and MSH traps ranged between seven and 35 days. The majority of steelhead marked at the traps were re-captured within one week of first capture. This is similar to findings for the Noyo River during 2000 (Gallagher 2000). This suggests that fish captured in the traps were actively emigrating. During electro-fishing, > 50% of the fish were recaptured above the traps more than 21 days post marking suggesting that these fish were not actively moving. Thedinga et al. (1994) states that 90% of marked and released steelhead in the Situk River, Alaska were captured within 6 days of release and that some fish traveled as far as 33 km/day. Because of weekly marking stratification it was not possible to determine maximum travel time for steelhead in the Noyo River during 2001. However, delayed travel above and below traps in weekly intervals was examined. Some fish marked in the traps were recaptured by electro-fishing above the traps more than 80 days after their original capture. Travel time for steelhead between NRS and MSH ranged from < 7 to 35 days and relatively few fish were recaptured. During 2001 about 15% of the stream trap panels at MSH did not block channel. Using more weir panels might increase recaptures at this trap.

Coho salmon travel time between traps was similar to that observed for steelhead during 2001. The time between marking and recapture of coho salmon for individual traps ranged between < 7 and 42 days. Coho salmon travel time between the upstream traps and the NRS and MSH traps ranged between seven and 49 days. The majority of marked coho salmon were re-captured within one week of first capture. This is similar to findings for the Noyo River during 2000 (Gallagher 2000).

Steelhead fry mortality in the Noyo River fyke traps during 2001 increased with increasing flow and thus catches. Maahs (1997) estimated fry mortality due to trapping in the South Fork Ten Mile at 25% and attributed at least some of this to predation by sculpin. Thedinga et al. (1994) estimated steelhead mortality at about 10% between traps located 17 km apart on the Situk River in Alaska and found handling mortality to be negligible. Mortality associated with trapping in the Noyo River during 2001 was similar to that reported by Thedinga et al. (1994) and Gallagher (2000). Steelhead and coho salmon mortality was similar during 2001. Generally, trap mortality increased with increased flow. The presence of adult Pacific lamprey in traps also appeared to increase trap mortality due to physical trauma from the larger fish thrashing about in the live car. Sculpin predation (Maahs 1997) may have contributed to the higher mortality observed at MSH as this trap had much higher sculpin captures than other traps in the Noyo River during 2001. Water temperatures were higher at MSH than other traps in the Noyo River during 2001 and may have increased mortality. Adding screens to limit lamprey and sculpin access to young coho and chinook salmon and steelhead may help reduce trap mortality.

Shapovalov and Taft (1954) found that steelhead survival from egg to smolt was 3% and ranged from zero for YOY to almost 18% for Y++. Burns (1972) found that steelhead YOY mortality in Caspar Creek averaged 73% from June to October and that year plus fish averaged 44% mortality over this period. The YOY survival based on mark-recapture estimates in the Noyo River averaged 0.75 (75%), thus mortality was 25%. This is considerably lower than that of Burns (1972) and similar to estimates from Gallagher (2000). Estimated YOY survival rates may be lower than estimated because fish < 70 mm were captured in the traps until the traps were removed from the streams whereas Y+ and Y++ size fish were not. Therefore, steelhead < 70 mm appear to be moving downstream through July and this may affect survival estimates. The average YOY 2000 to Y+ 2001 survival of 0.38 and the average Y+ summer survival of 0.55 are similar to the findings of Burns (1972). However, individual stream survival for YOY to Y+ is very low (Table 1). This is likely due to YOY and Y+ fish moving during winter high flows and thus many of these fish may be missed when traps are operating.

Age/size relationships that include scale analysis may better define age class separations by fork length and improve population and survival estimates of YOY, Y+, and Y++ populations. This is the second year of following the 2000 cohort. Although population confidence bounds were large, cohort survival was estimated. Continued examination of the 2000 cohort should provide Y+ to Y++ survival rates that may help identify instream limiting factors if they exist.

Stream Flow and Temperature

Loch et al (1988) found that downstream movement of juvenile steelhead in Washington was related to decreasing monthly flow and increasing water temperature. Captures and capture probabilities for Y+ steelhead in the Noyo River during 2001 were generally significantly positively associated with stream flow and negatively associated with temperature. This is opposite Loch et al. (1988) and similar to Gallagher (2000). The Y++ steelhead captures and capture probabilities were significantly associated with stream flow or temperature in two of seven cases. This is likely due to the low number of fish in this size/age class captured. Contrary to findings from 2000 (Gallagher 2000), movement of steelhead between 51-70 mm was generally associated with stream flow and temperature. These were generally the size of fish found in the traps later in the year and trapping did not continue as long as during 2000. They were considered YOY and maybe moving later in the year to find new rearing habitat lower in the system. However, Burns (1971) could not find evidence that streams reach carrying capacity in the summer. Movement of YOY and Y+ fish within a system, rather than actual emigration to the ocean, has been documented in other areas (Loch et al. 1988). Shapovalov and Taft (1954) state that steelhead may migrate downstream in spring and move back upstream in winter before migrating to the ocean. Everest (1973) found that summer steelhead smolts rear in the main stem Rogue River in summer and return to tributaries with winter freshets. There may be other seasonal triggers such as photoperiod that stimulate movement.

Coho salmon YOY and Y+ captures and capture probabilities were not consistently related to stream flow or temperature. The two traps and size/age classes for which trap capture and stream flow and temperature were significantly associated during 2000 (Gallagher 2000) showed the same result in 2001. One of the two traps and size/age classes for which capture probability and stream flow and temperature were significantly associated during 2000 (Gallagher 2000) showed the same result in 2001. Because stream flow and trap captures or capture probabilities were not consistently associated over two years, study designs that attempt to estimate capture based on stream flow when traps are not in place or operated using regression relationships (Maahs 1995) may have dubious results. Gallagher (2000) found both steelhead and coho salmon captures and capture probabilities significantly associated with steam flow. Whereas in 2001 these relationships were not as strong. This may be because stream flows were lower in spring and summer 2001 than in 2000. The average spring to summer flows during 2000 at all trap sites were up to 0.04 m^3/s higher than during 2001. The 2001 water year for the Noyo River was lower than most and consistently below the 49-year median during the trapping period.

Larger steelhead were captured in traps earlier in the year and the captures and capture probabilities were significantly associated with stream flow and temperature. Shapovalov and Taft (1954) found that most larger and older steelhead move between March and May in Waddell Creek and the highest proportion of all migrants is in spring and summer. They also state that migration during January through late-February is light due to high flows. Examination of Fig. 8 e shows that Y++ steelhead captures peaked during the week of 4 February 2001 (week 6) and that the percent captured on week 13 was similarly high. The trap was out between week six and 13 so that no inferences can be made for Noyo River winter steelhead movement. Ward and Slaney (1988) found most steelhead in the Keogh River British Columbia migrated in April and May and found no smolts moving in mid-winter. Therefore if traps were operated throughout the winter the association between flow, temperature, and trap captures might differ. However, even though it was not possible to operate the NRS through the entire winter, this trap showed significant relationships between capture and stream flow for the portion of the winter and spring it was in operation. Apparently the fyke traps used in the Noyo River during 2001 captured more larger steelhead when stream temperatures were low and flows were high. It may be that larger steelhead emigrate before temperatures rise and stream flows are low or they avoid traps altogether under these conditions. There is the possibility this is an adaptive response to avoid moving lower in the river where temperatures may exceed survival thresholds and sand berms may cut off access to the ocean.

Coho salmon Y+ appear to have moved past the traps by week 22 (27 May 2001). Again it appears from examining Fig. 12 e that Y+ coho salmon moved throughout the winter. Peak counts occurred during week 17 (22 April 2001). However, it is unknown how many fish moved between weeks six and 13. Similar to steelhead results, due to the physical limitations of operating traps through the winter this is likely to remain unknown.

Resident Population Estimates

The purpose of the electro-fishing mark recapture in the Noyo River during 2001 was, in part, to estimate rearing populations and fish. Harris (1999b) presents summer juvenile steelhead densities for three local creeks from 1986 to 1999 that ranged from 0.01 to 1.3/m^2. Burns (1971) found summer juvenile steelhead densities in Caspar Creek to range between 0.03 to 0.55/m^2 in 1967, 1968, and 1969. The average density observed in the Noyo River during 2000 was 0.11/m^2 (SE = 0.55/m^2) and ranged from 0.04 (SE = 0.14/m^2) to 1.21 (SE = 2.2/m^2) was similar to previously reported densities. Fish size was expected to be greater in traps than in the stream because smoltification changes body form and larger fish were expected to be moving. However, the opposite was the case for steelhead. Differences in size may be due to the electro-fishing residency study being conducted later in the year when larger fish had already moved past the traps or they moved before traps were installed. There was no clear pattern or significant difference in YOY or Y+ rearing population estimates between 2000 and 2001. Suggesting, at least at the level of intensity employed on the Noyo River, either populations between the two years were the same or that electro-fishing 2% of the Noyo River above NRS is insufficient for trend detection. However, the power of this analysis was low. Increasing the sample size and switching to removal type population estimation methodology might allow more sampling intensity at a similar cost while increasing the power of results. Adult steelhead population estimates were similar for 2000 and 2001 (Gallagher 2001). The percentage of steelhead residing during 2001 was much higher than during 2000. This may be due to the earlier termination of trapping and electro-fishing such that fewer > 50 mm YOY steelhead were included in population estimates, or fewer fish in this size class had moved past the traps before the study ended, or because flows were lower this season and fewer fish moved.

Young-of-the-Year Population Estimation and Prediction

YOY steelhead population estimates and predictions based on adult numbers derived from spawning surveys for the Noyo River during 2001 were not significantly different. The large variation in two-trap population estimate of YOY at NRS was strongly influenced by the difference between observed and expected estimates. The observed estimate from the two-trap method at NRS was very high due to large number of capture, marked, and released fish and very low number of recaptures. The uncertainty in adult population estimates for each segment was generally about one fish (Gallagher 2001). In cases where the difference between estimated and predicted YOY populations was more than two females it is likely that estimates were low due to the inability to mark and recapture fish < 50 mm. The total estimated YOY population for 2001 was not different than estimated for 2000 (Gallagher (2000). It appears that predicting YOY populations from adult observations may be a reasonable approach.

The YOY population estimate and the predicted population for the South Fork Noyo River differed by the predicted production of nine females because YOY caught in traps in the South Fork drainage were not completely enumerated as traps were opened to allow YOY to escape after weekly permit limits were reached (M. Knechtle, pers. comm.). Ten steelhead females were estimated to have spawned in the South Fork Noyo River (Gallagher 2001). The difference between observed and predicted YOY for the North Fork South Fork Noyo River are also likely due to trapping or estimation procedures. The simple life stage model developed here for the Noyo River seems to provide reasonable estimates of the YOY population and adds confidence to female population estimates based on redd counts. Continued monitoring of juvenile steelhead populations in the Noyo River may allow estimation of life stage specific survival which may help indicate fresh water habitat induced bottlenecks. The YOY and Y+ populations estimated during 2001 for the Noyo River provide a baseline cohort for long term monitoring. Steelhead YOY were predicted using an estimate of 80% survival from eggs to fry for streams with little silting (Shapovalov and Taft 1954). The lack of significant difference between estimated and predicted YOY steelhead populations in the Noyo River during 2000 and 2001 suggests that silting of spawning gravels may not be a limiting factor in the upper Noyo River. Female population estimates were derived from redd counts, which had a 2.6 % level of uncertainty (Gallagher 2001). Including this uncertainty in predicted population estimates would likely increase the overlap between estimated and predicted populations. Following the 2000 and 2001 cohorts in the Noyo River over a number of years should help identify habitat-induced bottlenecks if they exist. This type of model could be applied to other rivers to either estimate YOY populations or back-calculation of adult populations.

Recommendations for Further Study

Downstream movement and resident populations monitoring could be continued in the Noyo River to follow this season's YOY and Y+ population through successive life stages. This may allow the detection of habitat-induced population bottlenecks. Coordination with others working on this river to standardize methods in enumeration of YOY and juvenile salmonids will allow for large scale comparisons and monitoring of population trends. Age-length relationships should be developed for juvenile steelhead by scale reading in the Noyo River and this information should be used to track year classes and potentially improve population estimates.

Trapping should begin as early in the year as possible after high flows in January, February, or March. Running traps earlier and longer may increase the likely hood of capturing larger, assumed to be older steelhead. Modifying traps to increase their efficiency should also be done. Because all traps in the Noyo River showed similar capture trends over two years it is possible that the Noyo River basin is behaving as and representative of an independent population as defined by McElhany et al. (2000). It is important to note that, although the power of the tests was low, there was no significant difference in population estimates between 2000 and 2001. If the two-year trends are real, one or two traps might be all that is necessary for monitoring a watershed. This would allow trapping efforts to be expanded into more rivers. Because the trap just above the estuary at MSH showed a pattern similar to other traps in the Noyo River during 2001 it may be assumed this trap represents the river.

However, due to:

1). The inability to operate traps throughout the winter and spring.

2). The fact that year-to-year climate and therefore stream flows are extremely variable.

3). Differences between yearly climate make consistency in the year-to-year timing and duration of trapping difficult.

4). The idea that stream flows affect the number of fish moving, the timing of movement, the number of fish captured in traps, and that generally captures are significantly associated with stream flow.

5). The idea that even though traps appear to show similar trends over two years, they were not significant.

6). Four years of trapping data on the South Fork and North Fork South Fork Noyo River show no significant trends in fish captures, although there may not be any trends.

Trapping as a long-term monitoring tool should be approached cautiously.

Considering the above it is likely that management decisions based on inferences of change over time from trapping population estimates may be susceptible to type I and type II errors. On the other hand, continued monitoring using multiple traps and electro-fishing may allow continued examination of steelhead cohorts over successive years, may help better define the variability in steelhead life histories in the Noyo River, and hopefully may improve management prescriptions.

Acknowledgments

The Mendocino Redwood Company granted access to company property on the upper Noyo River. Thanks to the Mendocino Redwood Company for allowing us access to the river and the use of their roads. Charles Bellow graciously allowed access to the North Fork and roads to the upper North Fork. Christina Barrineau, Mellisa Berry, Brigitte Bondoux, Matt Coleman, Craig Comen, George Neillands, Alexander Pappas, and John Richardson helped conduct this study. Eric Bjorkstedt assisted with Darr analysis and developed the software used for parts of this study. Brigitte Bondoux, Matt Coleman, Morgan Knectle, and George Neillands provided helpful comments that improved this report.

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Eric Bjorkstedt. August 2001. National Marine Fisheries Service, Santa Cruz, CA

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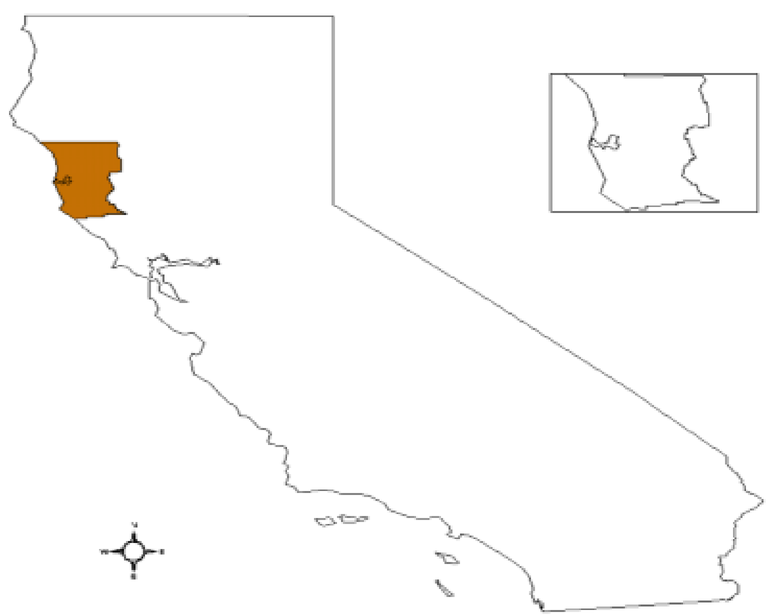

Fig. 1 Location of the Noyo River watershed and Mendocino County in California.

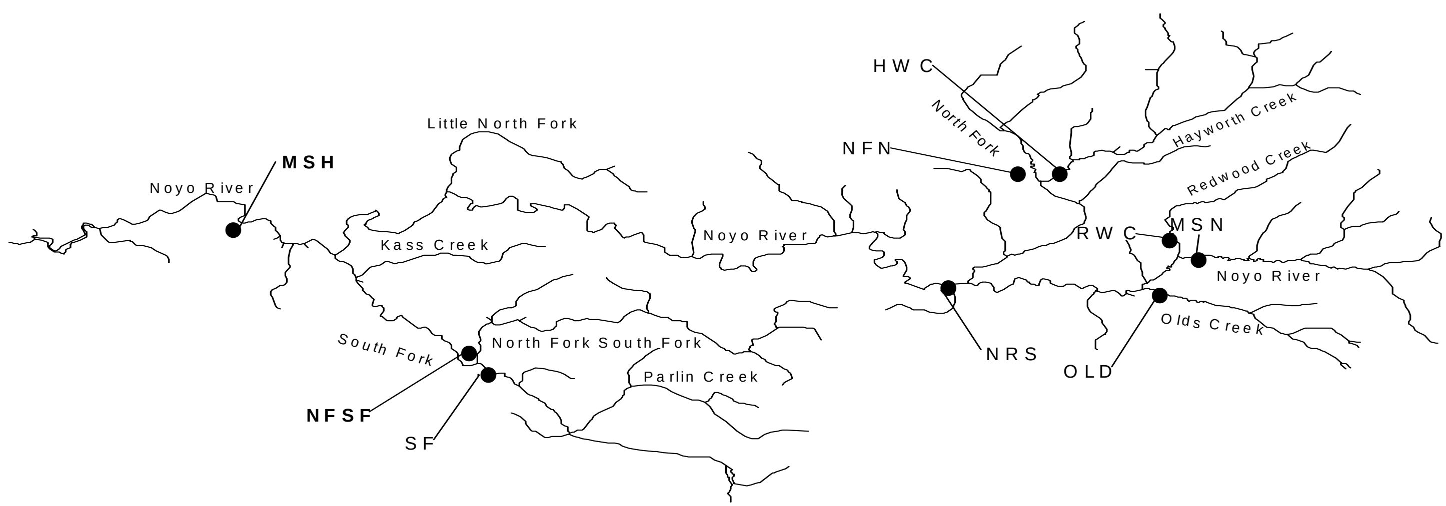

Fig. 2. Location of downstream fyke traps in the Noyo River during 2001. Circles indicate traps operated for this study. HWC is Hayworth Creek. MSH is Madsen Hole, MSN is the Noyo below Redwood Creek. NFN is the North Fork. NRS is Northspur. OLD is Olds Creek. RWC is Redwood Creek. SF is the South Fork. NFSF is the North Fork of the South Fork.

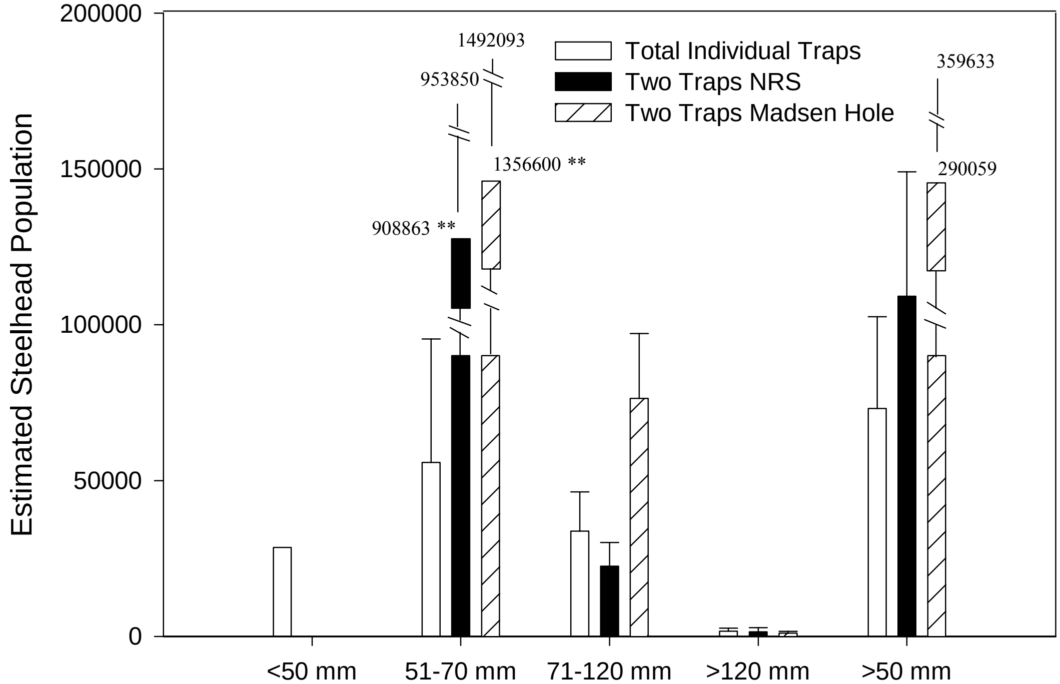

Fig. 3. Steelhead population estimates from the total of seven individual traps, and the two trap mark-recapture method for NRS and MSH. Thin bars are standard deviations.

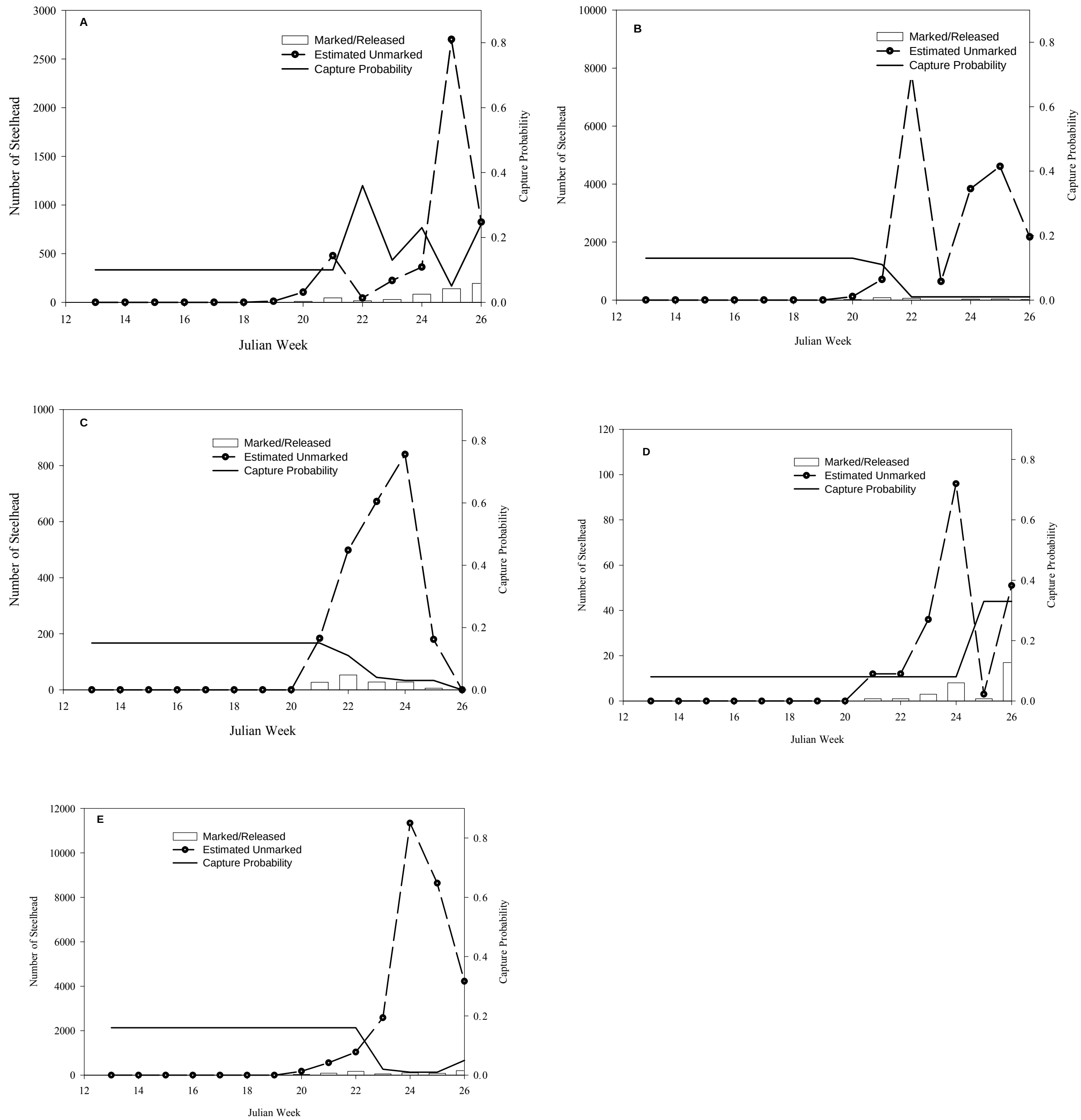

Fig. 4. Weekly population estimates, total captures, and capture probabilities for steelhead < 70 mm (YOY). A. HAY. B. MSH. C. MSN. D. NFN. E. NRS. Julian week 12 begins 19 March 2001. Note: Scales are different.

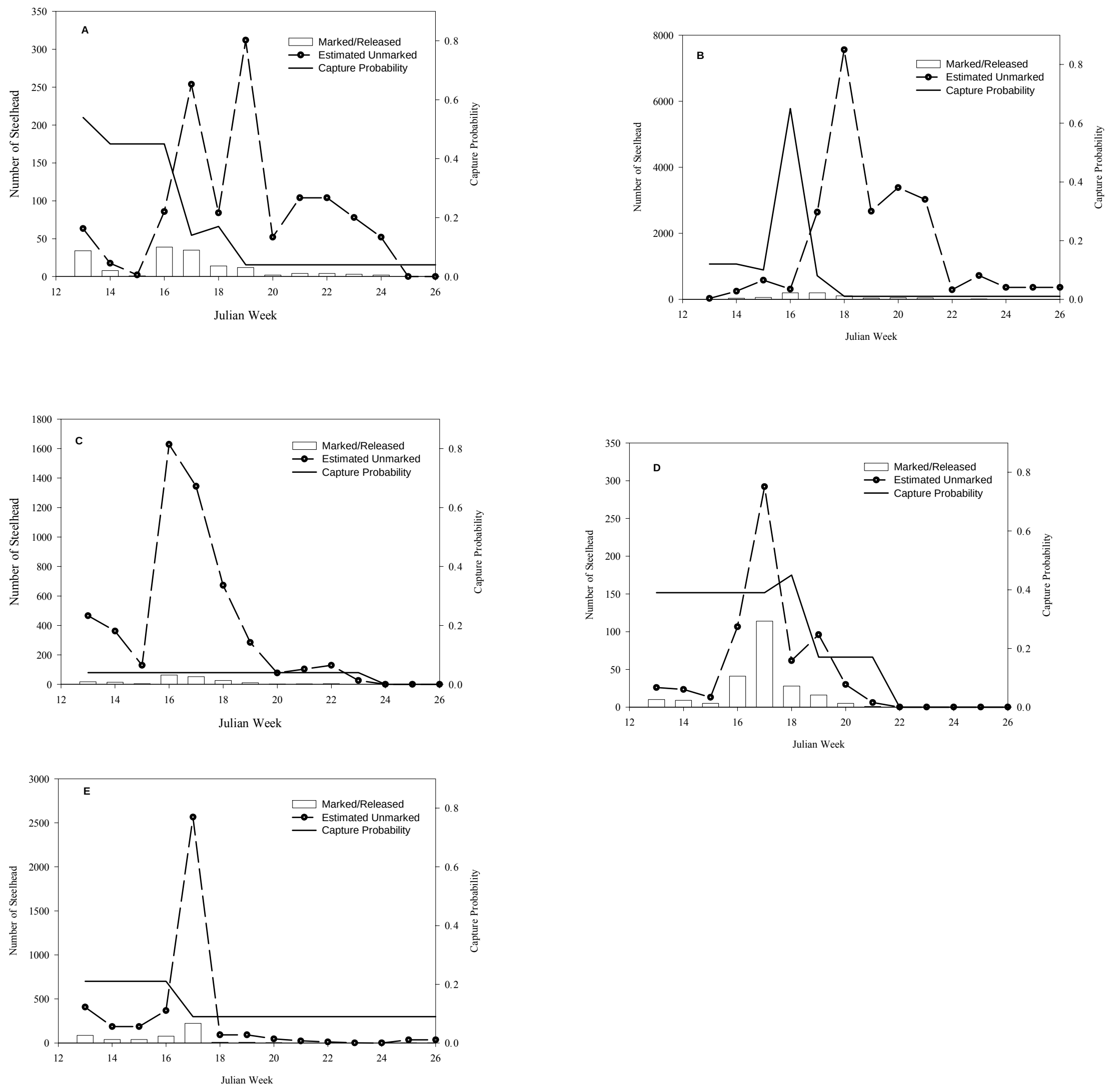

Fig. 5. Weekly population estimates, total captures, and capture probabilities for steelhead 71-120 mm (Y+). A. HAY. B. MSH. C. MSN. D. NFN. E. NRS. F. OLD. Julian week 12 begins 19 March 2001. Note: Scales are different.

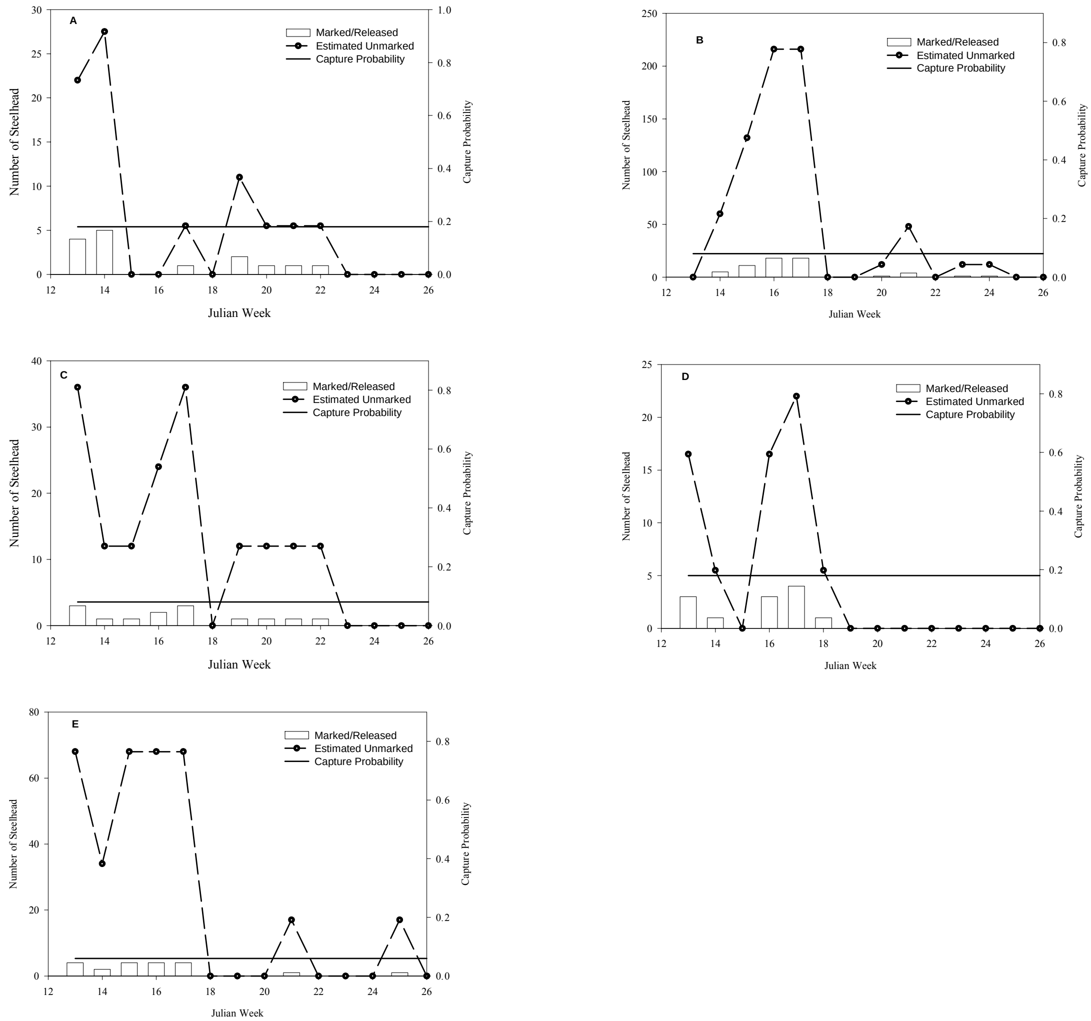

Fig. 6. Weekly population estimates, total captures, and capture probabilities for steelhead > 120mm (Y++). A. HAY. B. MSH. C. MSN. D. NFN. E. NRS. Julian week 12 begins 19 March 2001. Note: Scales are different.

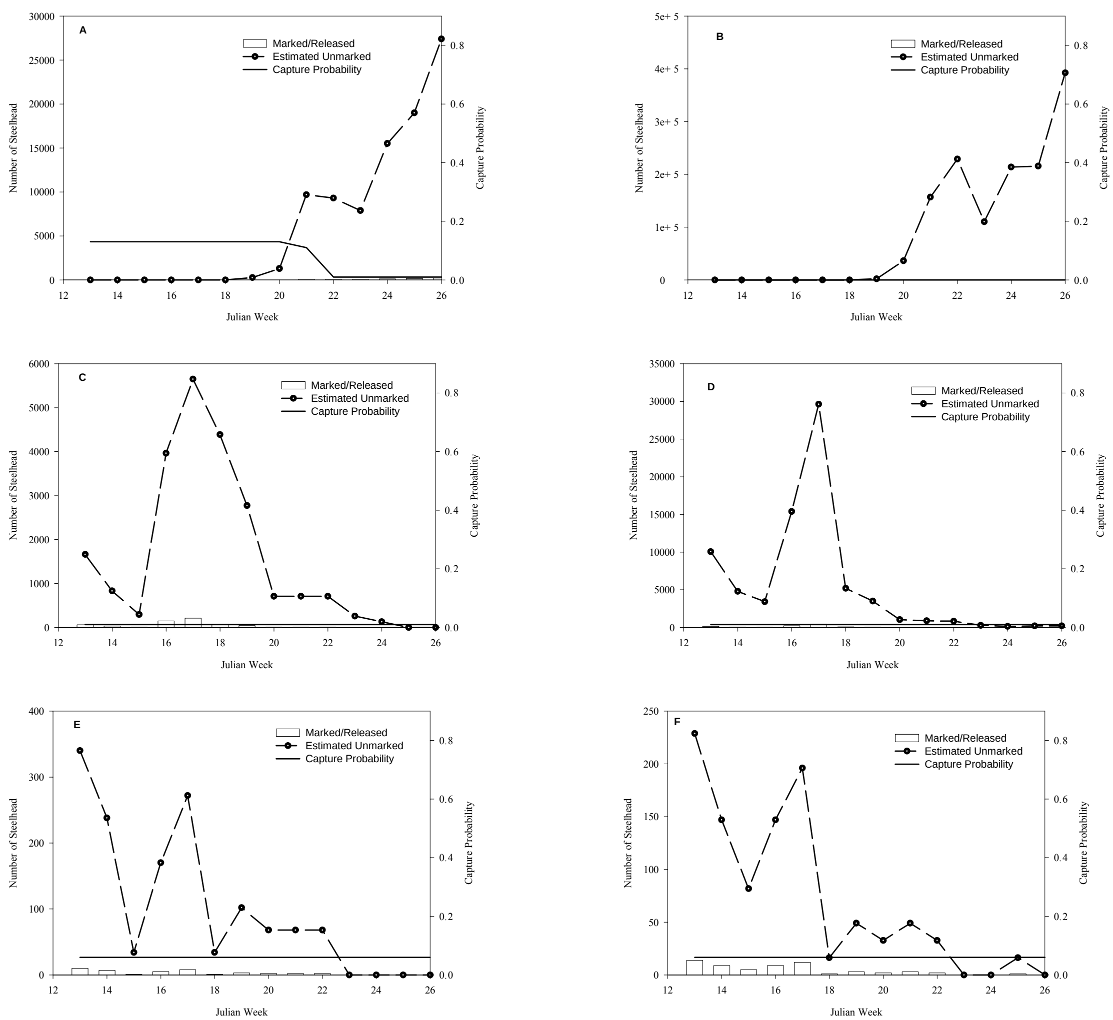

Fig. 7. Weekly population estimates, total captures, and capture probabilities from the two-trap mark-recapture method for steelhead. A. NRS < 70 mm. B. MSH < 70mm. C. NRS 71-120 mm. D. MSH 71-120 mm. E. NRS > 120 mm. F. MSH > 120 mm. Julian week 12 begins 19 March 2001. Note: Scales are different.

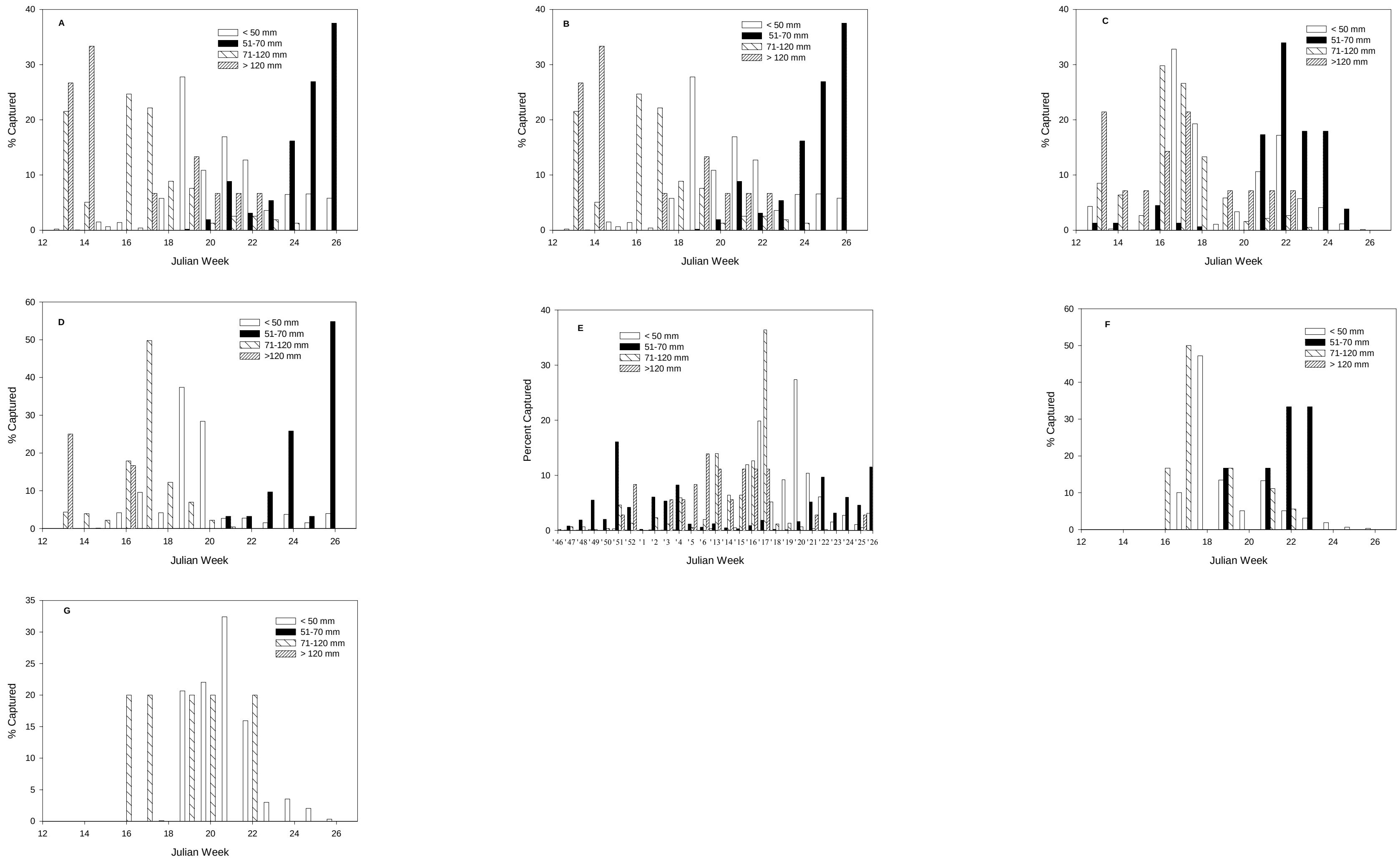

Fig. 8. Percentage of steelhead captured by week and size class in the Noyo River during 2001. A. HWC. B. MSH. C. MSN. D. NFN. E. NRS. F. OLD. G. RWC. Note: < 50-70 mm = YOY, 71-120 mm = Y+, > 120 mm = Y++.

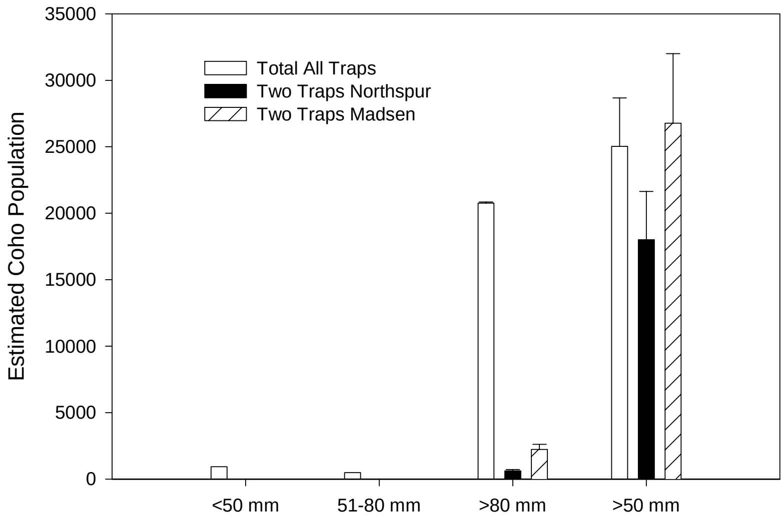

Fig. 9. Coho salmon population estimates from the total of seven individual traps, and the two trap mark-recapture method for NRS and MSH. Thin bars standard deviations.

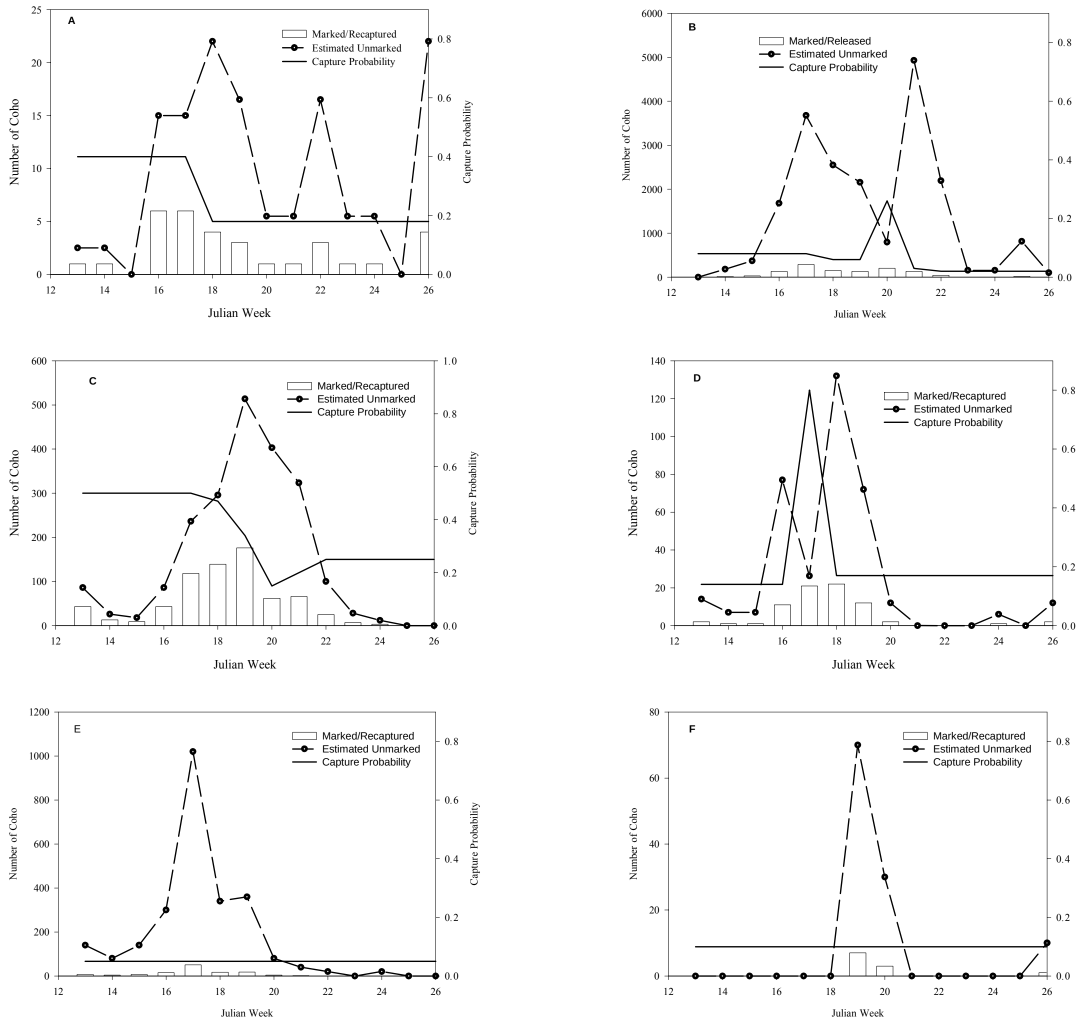

Fig. 10. Weekly population estimates, total captures, and capture probabilities for coho salmon > 50 mm (Y+). A. HAY. B. MSH. C. MSN. D. NFN. E. NRS. F. RWC. Julian week 12 begins 19 March 2001. Note: Scales are different.

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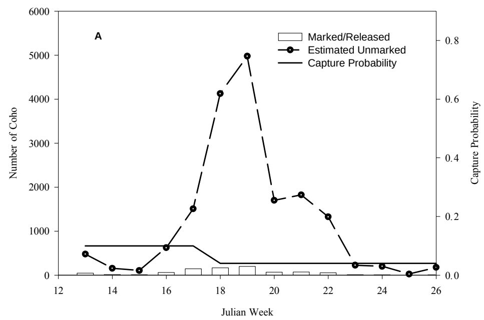

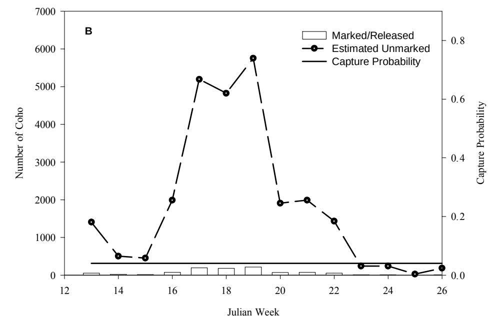

Fig. 11. Weekly population estimates, total captures, and capture probabilities from the two-trap mark-recapture method for coho salmon > 50 mm. A. NRS . B. MSH. Note: Scales are different

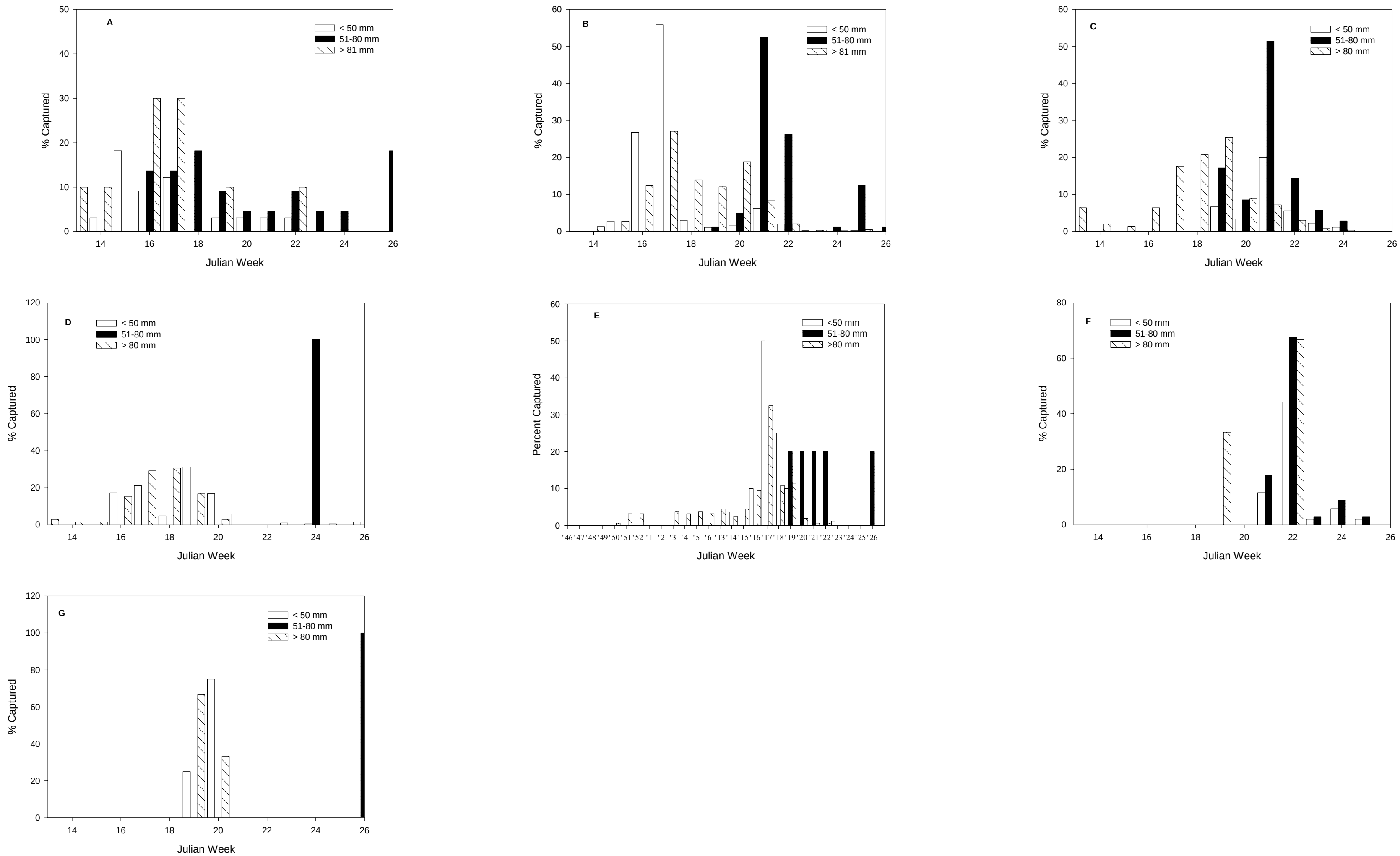

Fig. 12. Percentage of coho salmon captured by week and size class in the Noyo River during 2001. A. HWC. B. MSH. C. MSN. D. NFN. E. NRS. F. OLD. G. RWC. Julian week 12 begins 19 March 2001. Note: Scales are different.

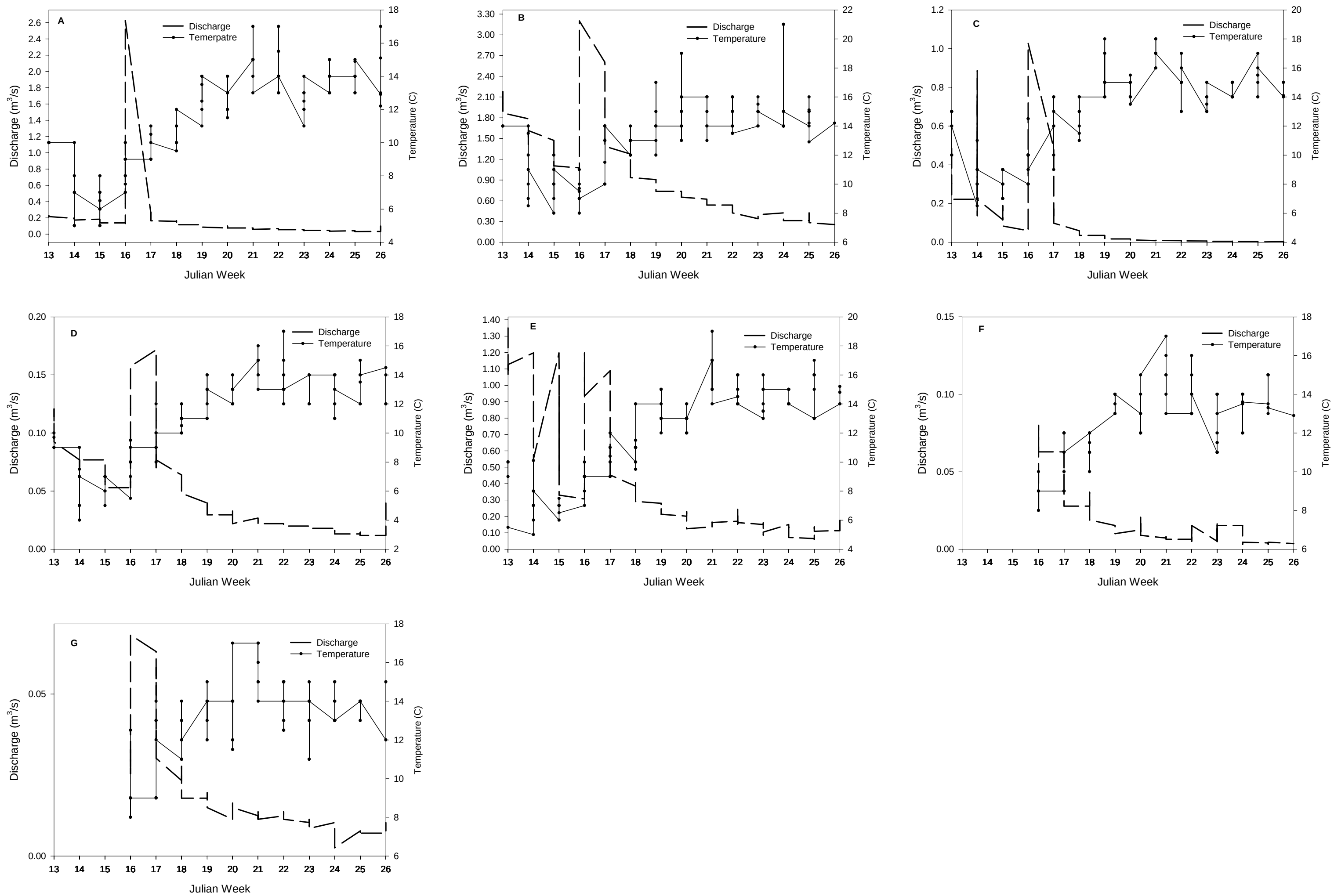

Fig. 13. Stream flow (m3/s) and water temperature © for seven trapping sites on the Noyo River during 2001. Week 13 begins on 26 March 2001. A. Hay. B. MSH. C. MSN. D. NFN. E. NRS. F. OLD. G. RWC.

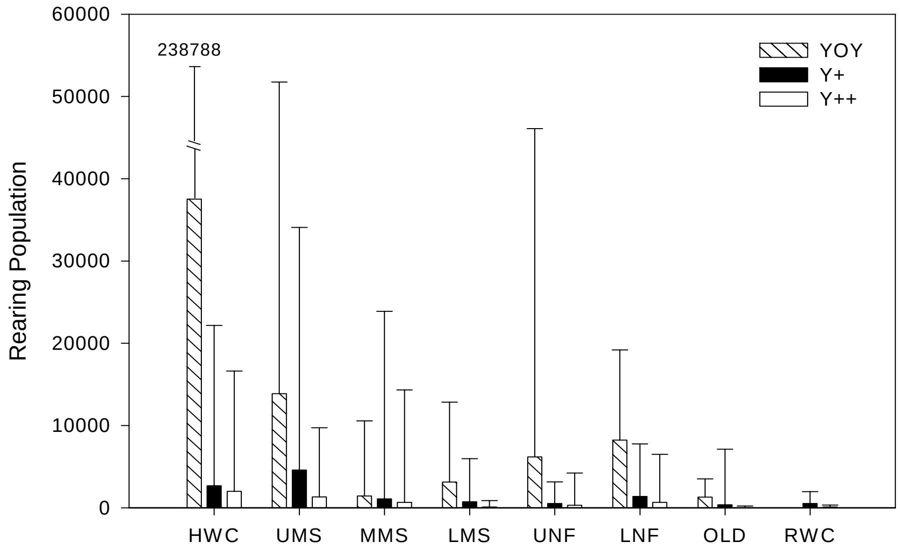

Fig. 14. Estimated rearing steelhead populations in eight stream reaches in the upper Noyo River during 2001. Thin lines are standard errors. Reach abbreviations are the same as Fig. 2 except UMS is the Noyo River above RWC, LMS is the Noyo River between NRS and OLD, MMS is the Noyo River between OLD and RWC, UNF is the NFN above HAY, and LNF is the NFN below HWC.

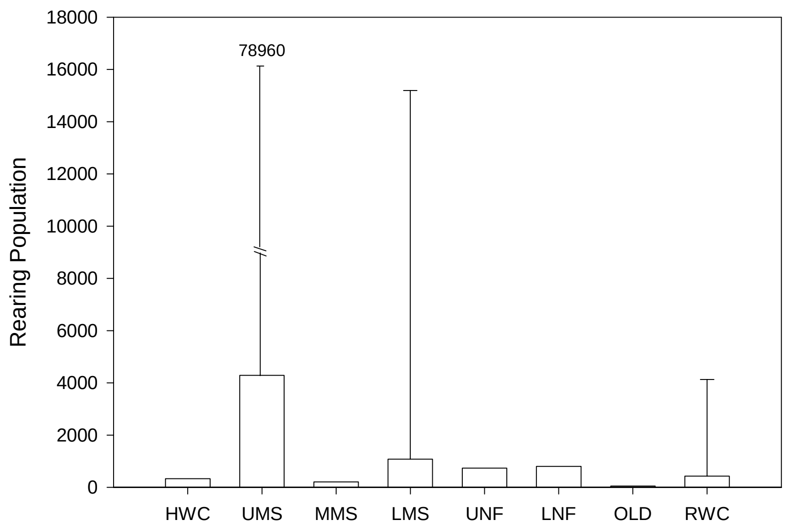

Fig. 15. Estimated rearing coho salmon populations in eight stream reaches in the upper Noyo River during 2001. Thin lines standard errors. Reach abbreviations are the same as Fig. 2 except UMS is the Noyo River above RWC, LMS is the Noyo River between NRS and OLD, MMS is the Noyo River between OLD and RWC, UNF is the NFN above HAY, and LNF is the NFN below HWC.

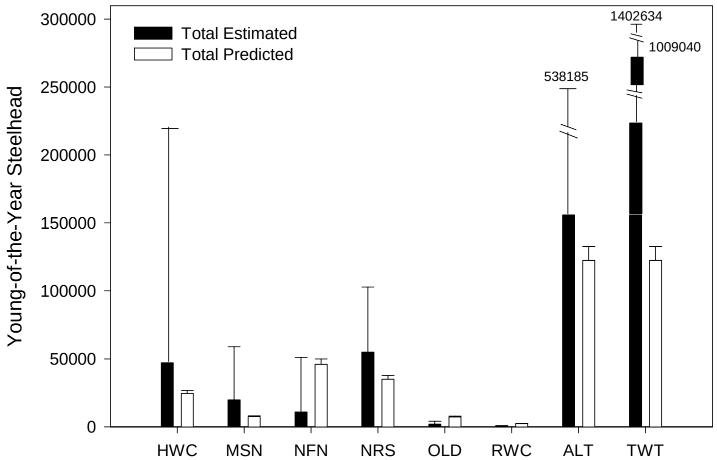

Fig. 16. Estimated and predicted YOY steelhead populations in the Noyo River by stream reach and the total above NRS during 2001. Abbreviations are the same as Fig. 2 and 14, except ALT is the total of all traps individually and stream reaches and TWT is the sum of the two-trap mark-recapture population estimate and stream reach estimates. Thin lines are standard deviations.

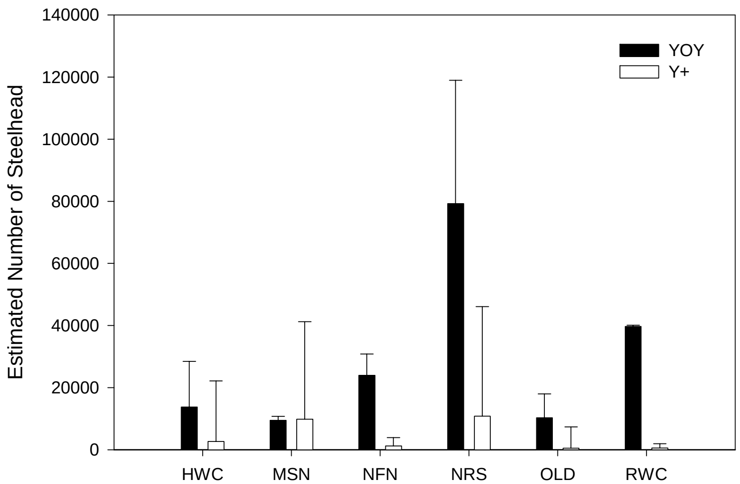

Fig. 17. Estimated number of YOY from 2000 and Y+ from 2001 trapping and electro-fishing.

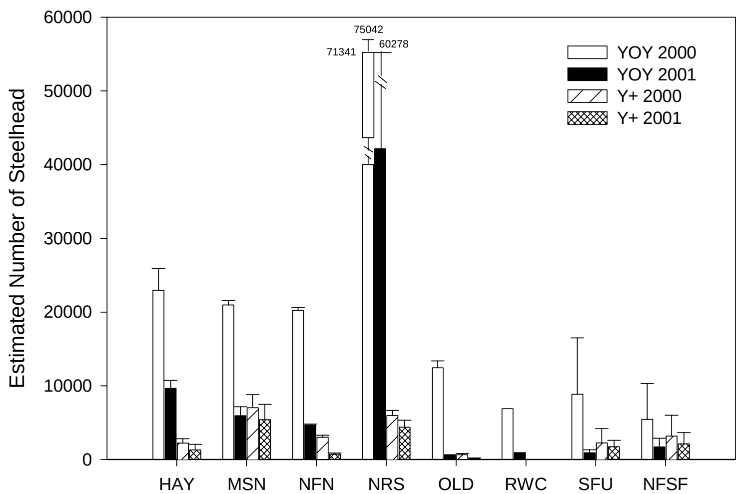

Fig. 18. YOY and Y+ steelhead trap population estimates from 2000 and 2001 in the Noyo River. SFU is the South Fork Noyo River and NFSF is the North Fork South Fork Noyo River.

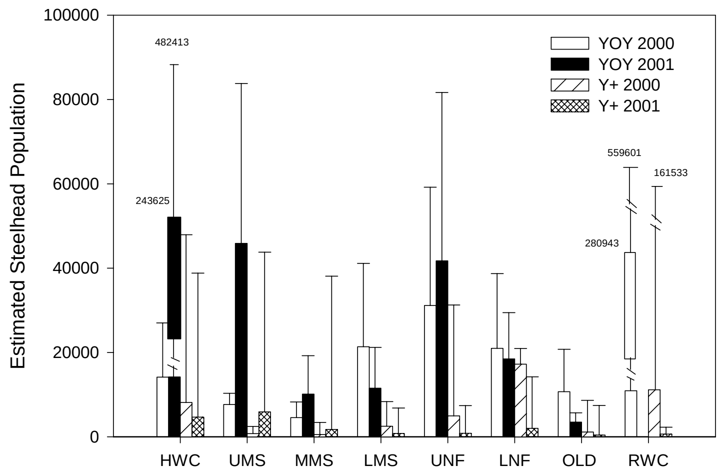

Fig. 19. YOY and Y+ steelhead population estimates from electro-fishing in the Noyo River during 2000 and 2001.

Table 1. Steelhead probability of survival from electro-fishing population estimates for 2001 and YOY 2000 to Y+ 2001 cohort survival from trapping and electro-fishing population estimates in the Noyo River, California during 2001.

Stream	< 71			71-120			> 120			YOY to Y+		Difference
	Low 95%	Estimated	High 95%	Low 95%	Estimated	High 95%	Low 95%	Estimated	High 95%	Estimated	High 95%	E-fish-YOY/Y+
HWC	0.15	0.75	4.92	0.13	0.29	0.55	0.04	0.19	0.36	0.28	0.85	0.00
MSN	0.29	0.75	2.03	0.29	0.75	2.03	0.29	0.75	2.03	1.04	3.84	0.29
NRS	0.07	0.63	6.44	0.11	0.40	1.77	0.13	0.44	1.68	0.14	0.39	-0.26
NFN	0.14	0.77	4.61	0.12	0.64	2.89	0.67	1.79	2.00	0.05	0.13	-0.59
OLD	0.10	0.84	6.61	0.09	0.74	5.39	0.35	0.85	1.60	0.05	0.41	-0.69
RWC	0.15	0.75	4.92	0.13	0.51	2.35	0.30	0.83	1.60	0.01	0.05	-0.50
AVG	0.15	0.75	4.92	0.15	0.55	2.50	0.30	0.81	1.54	0.38	1.30	-0.14

Table 2. Number of steelhead captured, population estimates (N), and capture probabilities for seven fyke traps, the total of all traps, and the two-trap method by size/age class in the Noyo River during 2001. Numbers in parentheses are standard deviations.

Trap Location	< 50 mm*	51-70 mm			71-120 mm			> 120 mm			> 50 mm		
		Total Captured	N	Capture Probability	Total Captured	N	Capture Probability	Total Captured	N	Capture Probability	Total Captured	N	Capture Probability
Hayworth Creek	4901	520	4749 (1076)	0.14	158	1209 (700)	0.18	15	82 (52)	0.18	693	5757 (1119)	0.27
Madsen Hole	452	243	19903 (18999)	0.08	746	22514 (9168)	0.08	59	708 (390)	0.08	1048	25146 (6669)	0.08
Mainstem Noyo	3561	156	2374 (1220)	0.12	188	5223 (1934)	0.04	14	168^ (160)	0.08	358	6869 (2232)	0.05
North Fork Noyo	4437	31	210 (155)	0.12	229	654 (117)	0.32	12	66^ (41)	0.18	272	1124 (309)	0.19
Northspur (Nov.-Feb.)	na	na	na	na	1054	3561 (269)	0.3	16	304^ (295)	0.05	1070	3716 (280)	0.3
Northspur (Mar.-July)	13591	814	28549 (18138)	0.12	490	4047 (622)	0.12	20	340^ (329)	0.06	1324	34002 (18974)	0.12
Olds Creek	648	6	0	-	18	126 (82)	0.14	0	0	-	24	216 (143)	0.11
Redwood Creek	935	0	0	-	5	0	-	0	0	-	5	0	-
Total Indivdual Traps	28525	1527	55785 (39588)	-	2888	33773 (12623)	-	136	1668 (972)	-	4551	73114 (29446)	-
Two Traps Northspur	-	699	908863 (44997)	0.01	613	22546 (7578)	0.03	41	1428^ (1373)	0.03	1353	109097 (39959)	0.02
Two Traps Madesn Hole	-	1427	1356600^ (135493)	0	1104	76386 (20783)	0.01	61	1045 (556)	0.06	2592	290059 (69574)	0.01

Table 3. . Number of coho salmon captured, population estimates (N), and capture probabilities for seven fyke traps, the total of all traps, and the two-trap method by size/age class in the Noyo River during 2001. Numbers in parentheses are standard deviations.

Trap Location	< 50 mm*	51-80 mm			> 80 mm			> 50 mm		
		Total Captured	N	Capture Probability	Total Captured	N	Capture Probability	Total Captured	N	Capture Probability
Hayworth Creek	33	22	99 (61)	0.22	10	50 (31)	0.2	32	134 (75)	0.26
Madesn Hole	467	80	3080 (2149)	0.03	1061	15828 (2429)	0.06	1141	19752 (4323)	0.06
Mainstem Noyo	90	35	393 (234)	0.1	669	1930 (263)	0.38	704	2128 (278)	0.35
North Fork Noyo	209	3	-	- -	72	342 (98)	0.2	75	365 (105)	0.21
Northspur (Nov.-Feb.)	0	0	-		0	-	-	33	80 (21)	0.43
Northspur (Mar.-July)	80	1	-	-	126	2520 (1227)	0.05	127	2540 (1237)	0.05
Olds Creek	52	28	-	-	3	-	-	31	-	-
Redwood Creek	4	1	-	-	10	90^ (84)	0.11	11	110^ (103)	0.1
Total Indivdual Traps	935	90	3572 (2210)	-	1951	20760 (17531)	-	859	25029 (6121)	-
Two Traps Northspur	-	731	-	-	131	630 (89)	0.28	986	18001 (3636)	0.06
Two Traps Madesn Hole	-	836	-	-	258	2232 (387)	0.13		26765 (5229)	0.04

Table 4. Total species captured and total species diversity (H') for each trap in the Noyo River during 2001.

Species	Common Name	Abbreviation	Total Captured						
			Hayworth Creek	Madsen Hole	Mainstem Noyo	North Fork	Northspur	Olds Creek	Redwood Creek
Clemmys marmorata	Western Pond Turtle	Clma	0	0	5	0	4	1	1
Cottus alueticus	Coast Sculpin	Coal	5	777	0	0	18	0	0
Cottus asper	Prickly Sculpin	Coas	1	204	0	0	5	0	0
Cymatogaster aggregata	Shiner Surfperch	Cyag	0	1	0	0	0	0	0
Dicamptodon ensatus	Pacific Giant Salamander	Dien	12	1	19	18	13	105	15
Gasterosteus aculeatus	Three-Spined Stickleback	Gaac	0	378	40	0	169	7	4
Hesperoleucus symmetricus	California Roach	Hesy	0	1	0	0	0	0	0
Hyla species	Tree Frog	Hysp	0	0	0	0	0	0	0
Lampetra tridentata	Pacific Lamprey	Latr	92	195	490	13	304	0	128
Rana aurora	Red-Legged Frog	Raau	0	0	1	1	3	3	0
Rana boylii	Foothill Yellow-Legged Frog	Rabo	23	9	60	42	31	13	22
Taricha granulosa	Rough-Skinned Newt	Tagr	7	8	23	3	6	2	3
Taricha rivularis	Red-Bellied Newt	Tari	12	3	5	2	5	1	0
Taricha torosa	California Newt	Tato	3	1	3	1	0	0	0
Thamnophis species	Garter Snake	Thsp	0	0	1	0	0	1	0
Oncorhynchus mykiss	Steelhead	Onmy	5594	1500	3919	4709	14915	672	940
Oncorhynchus kisutch	Coho Salmon	Onki	167	20219	2218	574	2620	83	15
Oncorhynchus tshawytscha	Chinook Salmon	Onts	0	1076	0	0	0	0	0
Species Diversity **H'**			0.122	0.315	0.431	0.188	0.248	0.357	0.269

Table 5. Percentage of trap branded steelhead recaptured by week in each trap and those recaptured above and below the traps during electro-fishing surveys in the Noyo River during 2001.

Trap	Total Recaptures	Time between capture and recapture (Days)														
		< 7	7-14	14-21	21-28	28-35	35-42	42-49	49-56	56-63	63-70	70-77	77-84	84-91	91-98	98-105
Hayworth Creek	85	87.1	7.1	2.4	0.0	2.4	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Madsen Hole	59	74.6	16.9	3.4	3.4	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mainstem Noyo	19	57.9	26.3	0.0	0.0	5.3	0.0	5.3	0.0	0.0	0.0	5.3	0.0	0.0	0.0	0.0
North Fork Noyo	66	60.6	28.8	3.0	1.5	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northspur Mar.-Jul.	77	71.4	13.0	3.9	5.2	3.9	1.3	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
Northspur Nov.-Feb.	171	57.3	17.5	7.0	9.9	5.8	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Olds Creek	3	66.7	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Redwood Creek	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Above Traps	53	11.3	22.6	1.9	17.0	5.7	5.7	0.0	7.5	7.5	7.5	5.7	0.0	0.0	0.0	1.9
Below Traps	12.0	25.0	8.3	8.3	0.0	16.7	8.3	8.3	8.3	8.3	0.0	0.0	0.0	0.0	0.0	0.0

Table 6. Percentage of steelhead marked and released in five traps above NRS and recaptured at NRS by week in the Noyo River during 2001.

Trap	Total Recaptures	Time between capture and recapture (Days)														
		< 7	7-14	14-21	21-28	28-35	35-42	42-49	49-56	56-63	63-70	70-77	77-84	84-91	91-98	98-105
Hayworth Creek	8.0	37.5	50.0	0.0	0.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mainstem Noyo	6.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Fork Noyo	6.0	33.3	50.0	0.0	0.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Olds Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Redwood Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 7. Percentage of steelhead marked and released in six traps above MSH and recaptured at MSH by week in the Noyo River during 2001.

Trap	Total	Time between capture and recapture (Days)														
	Recaptures	< 7	7-14	14-21	21-28	28-35	35-42	42-49	49-56	56-63	63-70	70-77	77-84	84-91	91-98	98-105
Hayworth Creek	1.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mainstem Noyo	1.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Fork Noyo	2.0	0.0	50.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northspur	13.0	0.0	30.8	23.1	23.1	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Olds Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Redwood Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 8. Percentage of fish marked and released during electro-fishing surveys recaptured above and below trap sites during subsequent electro-fishing surveys in the Noyo River during 2001 by week. Onmy is steelhead and Onki is coho salmon.

Trap	Species	Total	Time between capture and recapture (Days)															
		Recaptures	< 7	7-14	14-21	21-28	28-35	35-42	42-49	49-56	56-63	63-70	70-77	77-84	84-91	91-98	98-105	> 105
Above	Onmy	98.0	23.5	9.2	10.2	8.2	3.1	4.1	3.1	7.1	6.1	6.1	1.0	1.0	1.0	1.0	0.0	15.2
	Onki	12.0	0.0	58.3	25.0	0.0	8.3	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below	Onmy	61.0	13.1	4.9	8.2	21.3	9.8	11.5	4.9	0.0	0.0	0.0	13.1	1.6	4.9	0.0	1.6	4.9
	Onki	3.0	0.0	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3

Table 9. . Percentage of trap branded coho salmon recaptured by week in each trap and those recaptured above and below the traps during electro-fishing surveys in the Noyo River during 2001.

Trap	Total	Time between capture and recapture (Days)														
	Recaptures	< 7	7-14	14-21	21-28	28-35	35-42	42-49	49-56	56-63	63-70	70-77	77-84	84-91	91-98	98-105
Hayworth Creek	4.0	75.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Madsen Hole	52.0	69.2	26.9	1.9	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mainstem Noyo	157.0	68.2	26.1	1.9	2.5	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Fork Noyo	13.0	76.9	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northspur Mar.-Jul.	4.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northspur Nov.-Feb.	9.0	44.4	55.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Olds Creek	1*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Redwood Creek	1.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Above Traps	12.0	0.0	58.3	25.0	0.0	8.3	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Below Traps	3.0	0.0	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 10. Percentage of coho salmon marked and released in five traps above NRS and recaptured at NRS by week in the Noyo River during 2001.

Trap	Total	Time between capture and recapture (Days)														
	Recaptures	< 7	7-14	14-21	21-28	28-35	35-42	42-49	49-56	56-63	63-70	70-77	77-84	84-91	91-98	98-105
Hayworth Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mainstem Noyo	30.0	56.7	33.3	3.3	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Fork Noyo	1.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Olds Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Redwood Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 11. Percentage of coho salmon marked and released in six traps above MSH and recaptured at MSH by week in the Noyo River during 2001.

Trap	Total Recaptures	Time between capture and recapture (Days) < 7	7-14	14-21	21-28	28-35	35-42	42-49	49-56	56-63	63-70	70-77	77-84	84-91	91-98	98-105
Hayworth Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mainstem Noyo	16.0	0.0	62.5	25.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Fork Noyo	5.0	20.0	20.0	20.0	0.0	0.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northspur	3.0	0.0	33.3	0.0	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Olds Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Redwood Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 12. Results of correlation comparisons between daily steelhead trap captures and daily stream flow and water temperature for seven traps in the Noyo River during 2001.

Trap	Variable	< 50 mm	51-70 mm	71-120 mm	> 120 mm	All
Hayworth Cr.	Temperature	r = 0.44, p < 0.001	r = 0.41, p < 0.001	r = -0.18, p = 0.06	r = -0.11, p = 0.29	r = 0.49, p< 0.001
	Discharge	r = -0.15, p = 0.14	r = -0.13, p = 0.20	r = 0.04, p = 0.73	r = 0.03, p = 0.80	r = -0.17, p = 0.10
Madsen Hole	Temperature	r = 0.06, p = 0.56	r = 0.42, p < 0.001	r = -0.43, p < 0.001	r = -0.31, p = 0.005	r = -0.17, p = 0.13
	Discharge	r = 0.24, p = 0.02	r = -0.37, p < 0.001	r = 0.48, p < 0.001	r = 0.14, p = 0.18	r = 0.43, p < 0.001
Mainstem Noyo	Temperature	r = 0.11, p = 0.31	r = 0.29, p = 0.006	r = -0.26, p = 0.015	r = -0.10, p = 0.36	r = 0.10, p = 0.35
	Discharge	r = -0.08, p = 0.45	r = -0.12, p = 0.28	r = 0.53, p < 0.001	r = 0.17, p = 0.12	r = -0.05, p = 0.61
North Fork Noyo	Temperature	r = 0.19, p = 0.07	r = 0.06, p = 0.55	r = -0.22, p = 0.04	r = -0.17, p = 0.09	r = 0.17, p = 0.10
	Discharge	r = - 0.06, p = 0.56	r = 0.09, p = 0.37	r = 0.67, p < 0.001	r = 0.59, p < 0.001	r = -0.01, p = 0.88
Northspur	Temperature	r = 0.07, p = 0.48	r = 0.32, p = 0.002	r = -0.41, p < 0.001	r = -0.31, p = 0.003	r = 0.08, p = 0.45
	Discharge	r = -0.06, p = 0.55	r = -0.20, p 0.05	r = 0.60, p < 0.001	r = 0.31, p = 0.003	r = -0.05, p = 0.64
Olds Cr.	Temperature	r = -0.08, p = 0.48	r = 0.25, p = 0.03	r = -0.18, p = 0.13	-	r = -0.09, p = 0.46
	Discharge	r = 0.05, p = 0.63	r = -0.14, p = 0.23	r = 0.28, p = 0.02	-	r = 0.07, p = 0.58
Redwood Cr.	Temperature	r = 0.45, p < 0.001	-	r = -0.12, p = 0.33	-	r = 0.45, p < 0.001
	Discharge	r = -0.25, p = 0.04	-	r = 0.17, p = 0.16	-	r = -0.24, p = 0.04

Table 13. Results of correlation comparisons between daily coho salmon trap captures and daily stream flow and water temperature for seven traps in the Noyo River during 2001.

Trap	Variable	< 50 mm	> 50 mm	All
Hayworth Cr.	Temperature	r = -0.16, p = 0.12	r = 0.11, p = 0.29	r = -0.12, p = 0.25
	Discharge	r = 0.06, p = 0.54	r = -0.05, p = 0.66	r = 0.05, p = 0.65
Madsen Hole	Temperature	r = -0.29, p = 0.008	r = - 0.22, p = 0.05	r = -0.29, p = 0.008
	Discharge	r = 0.42, p < 0.001	r = 0.52, p < 0.001	r = 0.14, p = 0.19
Mainstem Noyo	Temperature	r = 0.001, p = 0.99	r = 0.10, p = 0.35	r = 0.11, p = 0.32
	Discharge	r = 0.22, p = 0.03	r = 0.003, p = 0.97	r = 0.09, p = 0.43
North Fork Noyo	Temperature	r = -0.006, p = 0.96	r = -0.12, p = 0.25	r = -0.05, p = 0.66
	Discharge	r = 0.24, p = 0.02	r = 0.31, p = 0.003	r = 0.31, p = 0.003
Northspur	Temperature	r = -0.12, p = 0.25	r = -.027, p = 0.01	r = -0.23, p = 0.03
	Discharge	r = 0.14, p = 0.18	r = 0.32, p = 0.002	r = 0.25, p = 0.01
Olds Cr.	Temperature	r = 0.23, p = 0.05	r = 0.21, p = 0.08	r = 0.29, p = 0.02
	Discharge	r = -0.19, p = 0.09	r = -0.18, p = 0.14	r = -0.24, p = 0.04
Redwood Cr.	Temperature	r = 0.07, p = 0.56	r = 0.14, p = 0.26	r = 0.15, p = 0.20
	Discharge	r = -0.03, p = 0.78	r = -0.05, p = 0.65	r = -0.06, p = 0.59

Table 14. Results of correlation comparisons between weekly capture probabilities and weekly stream flow and water temperature for seven traps in the Noyo River during 2001.

Trap	Variable	Steelhead				Coho
		All	51-70 mm	71-120 mm	> 120 mm	> 50 mm
Hayworth Cr.	Temperature	r = -0.80, p < 0.001	r = 0.41, p = 0.14	r = -0.86, p < 0.001	-	r = -0.88, p < 0.001
	Discharge	r = 0.24, p = 0.40	r = -0.30, p = 0.30	r = 0.40, p = 0.16	-	r = 0.72, p = 0.003
Madsen Hole	Temperature	r = -0.77, p < 0.001	r = -0.55, p = 0.04	r = - 0.68, p = 0.007	r = 0, p = 1.0	r = -0.23, p = 0.42
	Discharge	r = 0.61, p = 0.002	r = 0.77, p = 0.001	r = 0.43, p = 0.01	r = 0, p = 1.0	r = 0.29, p = 0.31
Mainstem Noyo	Temperature	r = 0.12, p = 0.67	r = -0.22, p = 0.45	r = 0.40, p = 0.16	r = 0.0001, p = 1.0	r = -0.83, p < 0.001
	Discharge	r = 0.009, p = 0.98	r = 0.02, p = 0.93	r = -0.68, p = 0.007	r = 0, p = 1.0	r = 0.81, p < 0.001
North Fork Noyo	Temperature	r = -0.72, p = 0.003	r = 0.30, p = 0.29	r = -0.82, p < 0.001	-	r = -0.09, p = 0.75
	Discharge	r = 0.82, p < 0.001	r = - 0.40, p = 0.16	r = 0.86, p < 0.001	-	r = 0.46, p = 0.10
Northspur	Temperature	r = -0.67, p = 0.009	r = -0.51, p = 0.006	r = -0.83, p < 0.001	-	-
	Discharge	r = 0.67, p = 0.008	r = 0.53, p = 0.05	r = 0.81, p = 0.001	-	-
Olds Cr.	Temperature	na	na	-	na	na
	Discharge	na	na	-	na	na
Redwood Cr.	Temperature	na	na	na	na	r = 0.0, p = 1.0
	Discharge	na	na	na	na	r = 0.0, p = 1.0

Table 15. Estimated number and 95% confidence levels of steelhead in eight reaches of the Noyo River during 2001.

Stream	Segment	Length (km)	Estimated Number/m									
			< 50 mm	51-70 mm			71-120 mm			> 120 mm		
				Low 95%	Estimated	High 95%	Low 95%	Estimated	High 95%	Low 95%	Estimated	High 95%
Hayworh Creek	Above Confulence	6.6	0.733	1.469	4.953	36.180	0.120	0.404	2.953	0.090	0.303	2.215
Noyo River	Above Redwood Cr.	4.85	1.643	0.375	1.216	7.815	0.292	0.945	6.078	0.083	0.270	1.737
Noyo River	Olds Cr. To Redwood Cr.	1.6	0.627	0.044	0.269	5.697	0.111	0.673	14.243	0.067	0.404	8.546
Noyo River	Northspur to Olds Cr.	5.02	0.366	0.282	0.259	1.931	0.106	0.144	1.044	0.086	0.015	0.156
North Fork Noyo	Above Hayworth Cr.	4.85	0.373	0.243	0.901	8.229	0.045	0.108	0.541	0.021	0.061	0.808
North Fork Noyo	Northspur to Hayworth Cr.	6.19	1.208	0.050	0.119	1.775	0.094	0.223	1.029	0.032	0.104	0.945
Olds Creek	Above Confulence	1.7	0.717	0.008	0.048	1.294	0.093	0.212	3.973	0.010	0.021	0.097
Redwood Creek	Above Confulence	3.7	0.000	0.000	0.000	0.000	0.083	0.142	0.386	0.014	0.024	0.064

Table 16. Estimated number and 95% confidence levels of coho salmon eight reaches of the Noyo River during 2001.

Stream	Segment	Length (km)	Estimated Number/m			
			< 50 mm	51-70 mm		
				Low 95%	Estimated	High 95%
Hayworh Creek	Above Confulence	6.6	0.000	na	0.050	na
Noyo River	Above Redwood Cr.	4.85	0.170	0.152	0.714	16.280
Noyo River	Olds Cr. To Redwood Cr.	1.6	0.053	na	0.073	na
Noyo River	Northspur to Olds Cr.	5.02	0.041	0.053	0.173	2.813
North Fork Noyo	Above Hayworth Cr.	4.85	0.040	na	0.111	na
North Fork Noyo	Northspur to Hayworth Cr.	6.19	0.040	0.023	0.089	1.762
Olds Creek	Above Confulence	1.7	0.093	na	0.116	na
Redwood Creek	Above Confulence	3.7	0.009	0.028	0.105	2.209

Table 17. Results of comparisons between steelhead fork lengths captured in traps and those captured by electro-fishing above traps in the Noyo River during spring 2001. One quarter and three quarter percentiles of the median values are listed in the 25% and 75% columns.

Site	Week	N		Median		25%		75%		*U*- Statistic	*p* -Value
		Trap	E-Fish	Trap	E-Fish	Trap	E-Fish	Trap	E-Fish		
Hayworth Cr.	16	113	12	30	74	29	34	80	88	897	0.06
	22	234	37	43	45	38	41	46	49	5760	0.04
	24	304	47	48	49	45	43	51	59	8847	0.21
	25	339	79	49	52	46	48	54	61	19620	< 0.001
	26	293	82	51	53	47	48	54	58	17606	0.001
Mainstem Noyo	16	69	27	80	79	73	75	92	90	1236	0.99
	19	52	27	33	40	31	36	41	95	1350	< 0.001
	23	195	58	45	49	42	43	49	89	8915	< 0.001
	24	171	39	45	49	42	45	49	58	5174	< 0.001
	25	64	48	46	48	43	45	49	56	3074	0.005
North Fork Noyo	16	202	11	30	75	29	71	40	97	1772	< 0.001
	22	125	16	37	45	34	40	39	96	1584	< 0.001
	24	168	26	41	50	38	43	44	85	3724	< 0.001
	25	69	47	40	43	38	39	44	55	3150	0.004
	26	73	49	43	45	40	40	49	52	3166	0.16
North Spur	16	303	9	30	84	29	79	73	89	2155	< 0.001
	22	345	44	48	45	43	38	54	55	7652	0.31
	23	195	39	47	41	42	35	51	46	3251	0.002
	24	260	44	49	47	40	42	54	56	6573	0.91
	25	173	54	47	45	38	41	53	51	6053	0.88
Olds Cr.	21	91	6	41	75	37	43	45	114	390	0.013
	11	37	13	43	90	38	49	46	116	462	< 0.001
	25	5	13	41	69	35	49	44	107	13	0.013
Redwood Cr.	23	28	37	34.5	38	33	36	36	40	564	< 0.001
	24	33	28	35	39	33	35	38	44	1072	0.003
	25	18	34	36	40	33	36	39	43	350	0.015

Table 17. Results of comparisons between coho salmon fork lengths captured in traps and those captured by electro-fishing above traps in the Noyo River during spring 2001. One quarter and three quarter percentiles of the median values are listed in the 25% and 75% columns.

Site	Week	N		Median		25%		75%		*t*- Value or *U* -Statistic	*p* -Value
		Trap	E-Fish	Trap	E-Fish	Trap	E-Fish	Trap	E-Fish		
Hayworth Cr.	16	7	9	65	48	37	44	99	50	50	0.57
	22	6	3	64	56	-	-	-	-	0.89	0.41
	26	5	5	62	68	-	-	-	-	-1.12	0.31
Mainstem Noyo	16	44	36	92	41	87	39	100	43	776	< 0.001
	19	170	16	98	48	92	45	103	55	221	< 0.001
	23	6	12	61	59	-	-	-	-	0.24	0.81
North Fork Noyo	26	6	15	52	54	-	-	-	-	-0.95	0.35
North Spur	16	24	5	90	68	37	44	95	91	49	0.68