Estimates of the Incidental Mortality of Wild Steelhead Caught and Released by Idaho Anglers, and Recommendations for Establishing Annual Take Limits Under Section 10 (a) (1) (B) of the Endangered Species Act

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ABSTRACT

On May 26, 2000 The National Marine Fisheries Service (NMFS) issued the Idaho Department of Fish and Game (IDFG) a permit under the authority of Section 10 (a) (1) (B) of the Endangered Species Act (ESA) for the incidental take of listed species associated with the conduct of sport fishing programs in Idaho. In May 2000, NMFS had not promulgated protective regulations under Section 4 (d) of the ESA for threatened Snake River steelhead, and therefore did not act on IDFG's application for an incidental take of steelhead during sport fisheries targeting unlisted hatchery-origin steelhead. However, NMFS stated that when take prohibitions are established they may amend Idaho's permit (Number 1233) to include authorization for the incidental take of steelhead as requested.

In 1997 and 1998, IDFG submitted Recreational Fishery Management Plans to NMFS designed to allow the steelhead fisheries to continue under Section 4(d) rules. In these documents, IDFG proposed two methods for estimating the incidental take of listed steelhead by the fishery directed at unlisted hatchery stocks. The first method proposed that the average long-term harvest rate on hatchery steelhead could be used as a surrogate for the encounter rate on wild steelhead. This method was designed to estimate the likely maximum level of incidental mortality. The second method reasoned that the encounter rate on wild steelhead is probably only half the harvest rate of hatchery stocks. The IDFG believed that this method produced a more likely estimate of incidental take, and was used to bracket the lower bound of the proposed range for establishing a take limit. Because of NMFS criticisms, a more quantitative method was sought to estimate incidental mortality.

In this report, I develop two quantitative methods for estimating the number of wild steelhead caught and released each year by recreational anglers in Idaho. The first method expands creel survey estimates of the encounter rates of wild steelhead by the ratio of estimated harvest determined by the Phone Survey, to the observed harvest in the Creel Survey. The second method estimates the encounter rate on wild fish by adjusting the exploitation rate on hatchery stocks by the proportion of hatchery fish that are caught by anglers and kept. I also examine the hypothesis that the number of hatchery steelhead harvested, and wild steelhead incidentally caught and released increases with the annual size of the run, and the amount of fishing effort.

During creel survey interviews, the number of hatchery and wild steelhead kept are observed and the number said to have been caught and released is recorded. Interviews are conducted each week on the Clearwater, Salmon, and lower Snake River (below the confluence of the Salmon and Snake Rivers at Lewiston), and reported for established sections of each river. Phone survey interviews provide estimates of the total number of hatchery fish harvested, the total number of wild steelhead caught and released, and the number of days fished by river section and month for each run-year. I expanded the number of steelhead caught and released as reported by anglers during the creel survey by the ratio of the number of hatchery fish kept obtained by the Phone Survey, to the number of hatchery fish kept seen during the Creel Survey. I made estimates for each fishing season (fall and spring), and for each River Section for the years 1990 - 2000. Estimates for the fall fishing season in a year were combined with estimates for the spring fishing season the following year to provide run-year estimates. Run-year estimates are reported

for the year of the fall fishing season to coincide with the year the fish entered the Columbia River on their spawning migration.

From 1990 to 2000, the estimated number of wild steelhead counted over Lower Granite Dam ranged from 7,354 to 19,978, and the number of hatchery fish ranged from 39,786 to 108,919. The majority of both the hatchery, and wild run steelhead each year were "A" run fish. There is a strong correlation between the annual run size (by run type) of wild and hatchery steelhead and this supports the hypothesis that similar environmental factors from the smolt to adult stage play an important role in determining annual abundance.

There was no trend for fishing effort to increase with run size, and there was no trend for the number of days fished to increase, or decrease over the period 1990 to 2000. Most (92%) of the annual variation in harvest of hatchery steelhead can be explained by variation in the annual abundance of hatchery steelhead, and fishing effort. While the annual abundance of wild steelhead can explain 62% in the variation in the number of wild steelhead caught and released, fishing effort does not contribute significantly to further explaining this variation, once annual abundance is taken into account.

Expansion of the reported number of steelhead caught and released in the Creel Survey for the years 1990 to 2000 ranged from 4,797 to 15,718. If 5% of the steelhead that are caught and released die, then the number of wild steelhead incidentally killed each year ranged from 240 to 786. The proportion of the annual run counted over Lower Granite Dam that is incidentally killed by catch and release fishing ranged from a low of 2.6 % in 1998, to a high of 6.1% in 1990 and averaged 4.25%. If 65% of the "A" run, and all "B" run steelhead counted over Lower Granite Dam enter Idaho, and they the occur in the fisheries in proportion to their abundance as counted over Lower Granite Dam, then the number of "A" and "B" run steelhead caught and released can be computed. If these assumptions are true, then in all but three years, the number of wild steelhead estimated to have been caught and released, is greater than the number estimated to have entered Idaho. On average 5.8, percent of the wild run entering Idaho each year are incidentally killed as a consequence of being caught and released. I believe this result is biased high.

The second method I developed for estimating the encounter rate on wild steelhead assumes that wild fish are encountered at the same rate as unlisted hatchery fish. To estimate the proportion of the annual run of hatchery fish that is encountered by anglers, I divided the harvest rate of hatchery stocks by the proportion of hatchery fish anglers caught that they kept. The average annual harvest rate for all run types and ages ranged from 64.8 percent to 78.3 percent, and averaged 72.9 percent. To estimate the number of hatchery fish that were caught and released each year, I expanded the Creel Survey data in the same way as was done to estimate the number of wild fish caught and released. The percent of hatchery steelhead caught that was kept each year ranged from 63.4 to 82.6, and averaged 72.3. Therefore, the average proportion of the annual hatchery run that is handled by anglers is 0.729 divided by 0.723 or 1.01. If the mortality of fish caught and released is 5%, then on average 5.01 percent of the wild run entering Idaho is incidentally killed as a result of being caught and released. There are at least three reasons why I think this result is also biased high. Considering that both estimates are likely biased high, I recommend NMFS use the lower of the two estimates (5%) to bracket the highest likely impact.

INTRODUCTION

Idaho fishing regulations (IDFG 2000) provide the opportunity for recreational anglers to harvest hatchery origin, unlisted steelhead and require them to immediately release, unharmed, any steelhead caught that possess an adipose fin. On May 26, 2000, the National Marine Fisheries Service (NMFS) issued the Idaho Department of Fish and Game (IDFG) a permit (Number 1233) under the authority of Section 10 (a) (1) (B) of the Endangered Species Act (ESA) for the incidental take of listed species associated with the conduct of sport fishing programs. In May 2000, NMFS had not promulgated protective regulations under Section 4 (d) of the ESA for threatened Snake River steelhead, and therefore did not act on IDFG's application for an incidental take of steelhead during sport fisheries targeting unlisted hatchery-origin steelhead. However, NMFS stated that when take prohibitions are established they may amend Idaho's permit to include authorization for take as requested.

In 1997 and 1998, IDFG submitted Recreational Fishery Management Plans to NMFS designed to allow the steelhead fisheries to continue under Section 4(d) rules (IDFG 1997, IDFG 1998). In these documents, IDFG proposed two methods for estimating the incidental take of listed steelhead by the fishery directed at unlisted hatchery stocks. The first method proposed that the average long-term harvest rate on hatchery steelhead could be used as a surrogate for the encounter rate on wild steelhead. This method was designed to estimate the likely maximum level of incidental take. The second method reasoned that the encounter rate on wild steelhead was perhaps only half the harvest rate of hatchery stocks because of extensive area and time closures to protect wild stocks. This method was used to bracket the lower bound of the proposed range for establishing a take limit. Because of NMFS criticism (Pollard 1997) IDFG conducted this research to develop alternative quantitative methods for estimating incidental mortality.

The first method I developed expands Creel Survey estimates of the encounter rates of wild steelhead by the ratio of estimated harvest, as determined by the Phone Survey, to the observed harvest in the Creel Survey. The second method I developed, estimates the encounter rate on wild fish by expanding the exploitation rate on hatchery stocks for the proportion of hatchery fish caught that are kept by anglers. A secondary objective I undertook as part of this research was to determine if the number of steelhead harvested, and incidentally caught and released, vary with the annual size of the run, and the amount of fishing effort.

METHODS

Abundance of Steelhead

Steelhead are counted over Lower Granite Dam, but annual estimates of run size into tributaries above the dam do not exist (Busby et. al. 1996). Mauser (personal communication) provided annual estimates of the number of hatchery and wild "A" and "B" run steelhead counted over

Lower Granite Dam. Use of Lower Granite Dam counts overestimates the number of steelhead entering Idaho, and therefore underestimates the proportion of the annual run that is caught and released. To estimate the number of steelhead entering Idaho, Kiefer (personal communication) suggests assuming that all the "B" run steelhead, and 65% of the "A" run steelhead counted over Lower Granite Dam are destined for Idaho. By assuming that "A" and "B" run fish occur in the fisheries in the same proportion as they are estimated to occur when they are counted over Lower Granite Dam, then it is also possible to estimate the number caught and released for each run type.

Phone Survey

IDFG conducts a phone survey to estimate the number of steelhead harvested each year. The method used is described in McArthur (1992). Because Idaho requires anglers to record the date, and location of each steelhead harvested on a "punch card", and an angler can reference this record during the survey, this method is considered the department's best estimate of the number of fish harvested. The Phone Survey also provides estimates of the number of hatchery and wild fish caught and released, and the number of days fished, but because these data are not recorded, the angler must recall this information from memory. Because a concern exists about the accuracy of the estimate of the number caught and released that must be recalled from memory (McArthur 1992), an alternative method was developed to estimate this variable.

Expansion of Creel Survey Data to Estimate the Number of Wild Steelhead Caught and Released

IDFG conducts a creel survey on the lower Snake River, Salmon River, and Clearwater River (see for example, Ball 2001). The primary purposes of this program are to sample the catch for biological data, and for coded microwire tags. During interviews, the number of hatchery, and wild fish harvested is observed, and the number of hatchery, and wild fish said to have been caught and released is recorded. The Creel Survey program does not estimate the fraction of the effort sampled. To estimate the total number of hatchery and wild fish caught and released, I multiplied the number reported by anglers (by river section and season) by the ratio of the number of fish harvested (also by river section and season) obtained by the Phone Survey to the number of fish observed in the Creel Survey.

Because the Creel Survey program does not interview anglers in all time and area strata where steelhead fishing is allowed, I expanded estimates of the number of fish caught and released for a year by the ratio of annual phone survey estimate of total harvest to the number harvested in the sampled strata. The percent of the catch that occurred in a stratum that was sampled ranged from 89% to 95%, and averaged 92%; thus expansion factors varied from 1.13 to 1.06, and averaged 1.09.

Incidental Mortality

NMFS (1999) in its 4(d) rules for steelhead noted:

> "Research conducted in the Northwest United States, and British Columbia indicates that adult steelhead can be hooked, landed, and released using recreational fishing equipment with an average mortality rate of less than 5 %…. ."

I used 5% as an estimate of mortality for the number of wild steelhead caught, and released on recreational fishing gear in Idaho.

Harvest Rate Approach for Estimating Incidental Mortality

The harvest rate approach for estimating the incidental mortality of wild steelhead caught and released involves four steps. First, is computing the average harvest rate for hatchery stocks. Ball (1994, 1996, 1998a, 1998b, 1999, 2001) provided estimates of the number of tagged hatchery steelhead harvested in Idaho[1], and that escaped the fisheries for the run-years 1991-1996. I used these data to compute the harvest rate for "A" and "B" run steelhead by ocean age each year. The second step is to estimate the proportion of the hatchery fish caught that are kept. To accomplish this, I estimated the number of hatchery fish that were caught and released each year by expanding the Creel Survey data in the same way as I did to estimate the number of wild fish caught and released. Third, I divided the harvest rate in a year by the average proportion of the number of fish caught that are kept. Last, I multiplied this result by the estimated mortality rate (5%) of fish that are caught and released.

Geographic Scope

Data collected from the Snake River or tributaries of the Snake above the confluence of the Salmon River was excluded from the analysis.

RESULTS

Annual Abundance

From 1990 to 2000, the number of wild steelhead estimated to have crossed Lower Granite Dam (Table 1, Figure 1, and Figure 2) ranged from 7,354 to 19,978, and the number of hatchery steelhead ranged from 39,786 to 108,919. The majority of both the hatchery, and wild run steelhead each year were "A" run fish. The average ratio of "A" run wild fish to "A" run hatchery fish was 0.16. The average ratio of "B" run wild fish to "B" run hatchery fish was 0.18.

[1] The reports of Ball focus on evaluation of hatcheries supported by the Lower Snake River Compensation Program.

There is a strong correlation between the annual run of wild and hatchery "A" run fish (r = 0.748**) and "B" run fish (r = 0.795**), which suggests that similar environmental factors from the smolt to adult stage play an important role in determining annual abundance.

Fishing Effort

The estimated number of days fished based on the Phone Survey varied from a low of 119,033 to a high of 206,843. There is no trend (F = 3.2 with 1,9 df) for the annual effort to increase with run size (Figure 3). Furthermore, there is no trend for the number of days fished to increase, or decrease over the period 1990 to 2000, (Figure 4).

Factors Influencing the Annual Harvest of Hatchery Steelhead

There is a significant linear relationship (F = 24.4, 9 df **) between the number of hatchery steelhead estimated to have been harvested in the Phone Survey and number of hatchery fish counted over Lower Granite Dam (Figure 5). There is also a significant (F = 14.6, 9 df **) linear relationship between the annual harvest of hatchery steelhead, and the number of days fished (Figure 6). The model that used abundance explained 73 percent of the variation in harvest, while the model that used effort explained 62 percent of the variation in harvest. These results suggested that a multiple linear regression model might better explain, and predict harvest.

A multiple regression model of abundance, and effort explained 92 percent of the variation in harvest, and was significant (F = 46.2, 2,8 df **). T-tests of the parameters for abundance (t=5.5 **), and effort (t=4.36 **) indicate that both variables are greater than zero when used concurrently. The equation for this regression model is:

$$y = -7438.9 + 0.1154\ a + 0.2319\ b$$

where;

y = annual harvest of hatchery steelhead,

a = number of days fished,

b = number of hatchery fish counted over Lower Granite Dam.

Expanded Creel Survey Estimates of the Number of Wild Fish Caught and Released

The estimated number of wild steelhead caught and released in Idaho based on expansion of the Creel Survey data for the years 1990 to 2000 ranged from a low of 6,115 in 1995, to a high of 14,044 in 1992 (Table 3).

There is a significant linear relationship (F = 16.2, 9 df **) between the number of wild steelhead caught and released in Idaho, and the number of wild steelhead counted over Lower Granite Dam (Figure 7). There is also a significant (F = 5.86, 9 df *), but much weaker, linear relationship between the number of wild steelhead caught and released in Idaho, and the number of days fished (Figure 7). The model that used abundance explained 64 percent of the variation in the number caught and released, while the model that used effort explained only 39 percent of the variation.

A multiple regression model of abundance, and effort explained 68 percent of the variation in harvest, a very small increase over the single parameter model that used abundance. In fact, t - tests of the parameters indicates that while the coefficient for abundance is significantly greater than zero (t = 2.71*) the coefficient for effort was not significantly greater than zero (t = 1.03). Therefore, the best predictor of the number caught and released is the one-parameter model that used abundance, the equation is:

$$y = 2867.9 + 0.564\ a$$

where;

y = number of wild steelhead caught and released in Idaho,

a = number of wild steelhead counted over Lower Granite Dam.

Expanded Creel Survey Estimates of the Incidental Mortality of Wild Fish Caught and Released

If 5 percent of the steelhead caught and released die, then the estimated number of wild steelhead incidentally killed as a consequence of being caught and released ranged from a low of 240 in 1998, to a high of 786 in 1991, and averaged 465. The percent of the total run over Lower Granite Dam estimated to have been incidentally killed ranged from a low of 2.9 % in 2000, to a high of 6.1 % in 1990, and averaged 4.3 percent.

If 65% of the "A" run, and all the "B" run steelhead counted over Lower Granite Dam enter Idaho, and they the occur in the fisheries in proportion to their abundance as counted over Lower Granite Dam, then the number of "A" and "B" run steelhead caught and released can be computed. Using these assumptions an average of 5.8 percent of the wild run entering Idaho is incidentally killed as a result of being caught and released (Table 5).

Expanded Creel Survey Estimates of the Number Wild Steelhead Kept

Occasionally, a wild steelhead was observed during a creel survey interview. The estimated total number of wild steelhead kept (Table 4) indicates that the incidence of anglers unlawfully retaining steelhead has decreased since 1991, to a very low level, and averaged only 8.5 fish per year, but there are reasons to believe that estimates in 1990 and 1991 are biased high.

Harvest Rate Based Estimates of Incidental Mortality

For the run-years 1991-1996, the average annual harvest rate for all run types and ages ranged from 64.8 percent to 78.3 percent, and averaged 72.9 percent (Table 6). The percent of hatchery steelhead caught each year that was kept, ranged from 63.4 to 82.6, and averaged 72.3 (Table 7). Thus, the average proportion of the annual hatchery run that is handled by anglers is 0.729 divided by 0.723 or 1.01. If this is the same rate at which wild fish are encountered, and the mortality of fish caught and released is 5%, then on average 5.01 percent of the wild run entering Idaho is incidentally killed as a result of being caught and released.

DISCUSSION

The Phone Survey data, although unpublished since the 1990 run year, is considered final. However, the Creel Survey data used in this report is not considered final. While the Creel Survey program has collected information on the numbers of steelhead caught and released, annual estimates of the total number have not been published, nor has the data been maintained in common database. Because of the need to provide NMFS this analysis in a timely fashion, the data used in this report was pieced together by combining a large number of individual spreadsheets. While care was taken to review, edit, and check for errors in the final spreadsheet, this process may have introduced errors into the data set. When, the department develops a database for the Creel Survey data, it is possible that small differences will be found between the department's final data and the data used in this report.

Variance and Bias of Expanded Creel Survey Estimates

There are two primary sources of variability in the estimated numbers of wild steelhead caught and released; a) the sample statistics obtained during the Creel Survey, and b) the sample statistics used to estimate total catch from the Phone Survey. Variances have been computed for the Phone Survey, but not for the Creel Survey. This makes it impossible to provide confidence intervals for the estimated number of fish caught, and released. It may, however be instructive to note that the 90 percent confidence intervals for the estimates of the number of fish kept averages about 9% of the mean for the last four years of the Phone Survey. When the department develops a database for the Creel Survey data, it will be practical to estimate the variance of the number of fish caught and released each year.

Why a very high proportion of the variability in annual harvest (92%) can be explained by the annual abundance and effort, but that a much smaller proportion of the variability in number caught and released (62%) is explained by abundance, and why effort is not an important variable, will require further research to understand. My suspicion is that the inability to explain a higher proportion of variability is caused by one or more of the following; a) imprecise and/or biased estimates of the total number of steelhead caught and released, b) imprecise and/or biased estimates of the proportion of the number caught and released that are wild and hatchery fish, or c) the range of values for angler days fished is too small to capture the effect of effort.

I believe it is unlikely that the number of wild steelhead caught and released each year is greater than the number of fish estimated to have entered Idaho in all but 3 years (see Table 5). There are four possible reasons for this result. First, estimates of the number of fish counted over Lower Granite Dam are biased low. Second, the assumption that 65% of the "A" run steelhead counted over Lower granite Dam may be biased low. Third, expansion of the number caught and released, based on the ratio of the harvest in the Phone Survey to the observed harvest in the Creel Survey is biased high because the number reported as caught in the phone survey, is biased high. Fourth, the number reported to have been caught and released by the Creel Survey Program is biased high. The latter source of possible bias includes both the number of fish caught and released, and the angler's ability to correctly differentiate wild and hatchery fish. Based on observations of enforcement staff, there is special concern for the number of fish reported to have been caught and released by anglers during interviews. In addition, because estimates of the number of wild fish caught and released in the Phone Survey is 2.3 times higher than in this study, further doubt is cast on the accuracy of numbers reported by anglers when no records are kept. This bias may occur because some anglers are unwilling to admit they caught no fish, or because they exaggerate their success when interviewed as part of ether the Creel Survey or Phone Survey.

Harvest Rate Method

In our proposed Recreational Fishery Management and Evaluation Plans (RFMEP) (IDFG 1997; IDFG 1998) we proposed that the average long-term harvest rate on hatchery steelhead[2] could be used as a surrogate for the encounter rate on wild steelhead. There are two problems with this method. First, the approach failed to account for IDFG regulations that protect natural spawning fish, and that help focus fishing effort on hatchery stocks in the spring fishing season. Failing to account for these factors will tend to overestimate the number of fish encountered. The second problem is that some hatchery fish are caught and released. Failing to account for this factor will tend to underestimate the number of fish encountered. Because my approach accounted for the number of hatchery fish caught and released, but not for are and time closures, the final estimate is biased high.

The use of the harvest rate on hatchery stocks, adjusted for the proportion of hatchery fish estimated to have been caught and kept, likely overestimates the encounter rate on wild fish for at least three reasons. First, Idaho's fishing regulations close large areas of the Clearwater River (e.g. the Lochsa, Selway) and the Salmon River (e.g. all tributaries except a portion of the Little Salmon River) to fishing. These closed areas likely provide a refuge in the spring when wild steelhead migrate toward, and onto the spawning grounds. Second, in the spring, many anglers target concentrations of hatchery fish, in for example, the upper Salmon River and the North Fork of the Clearwater. This targeting of hatchery fish by anglers increases the harvest rate on hatchery fish relative to wild fish. Third, as previously noted, anglers may report more fish as having been caught and released than actually occurred. To account for bias in the estimate based on hatchery harvest rates, IDFG's (1997, 1998) professional judgment was that the encounter rate for wild steelhead might be only one-half that for hatchery fish. If that judgment

[2] In both reports, IDFG suggested that the long term average harvest rate was 60 percent, but provided no data, or references.

is true, then the incidental mortality on wild stocks as a result of being hooked and released would be 2.5% not 5%.

Hooking Mortality

While I assumed that 5% of fish the fish caught and released would die, in perhaps the most cited study of steelhead mortality, Hooton (1987) reported a mortality rate of 3.4% for 3,715 steelhead caught for broodstock in British Columbia over a seven-year period. Although Hooton (2001) identified reason's why this mortality rate should be considered a minimal estimate, two other often cited studies (Hooton 1987; Thomas 1995) reported mortality rates for steelhead caught with artificial bait of 3.8% and 4.55 %. This is perhaps why NMFS (1999) in its 4(d) rules for steelhead noted that the average mortality rate is likely less than 5%. If the average hooking mortality is less than the 5% then my estimates will be biased high accordingly.

Number of Wild Steelhead Kept

It is a rare event when an angler is seen at a check station with a wild steelhead that has been unlawfully retained. During the creel survey, if a small proportion of the estimated harvest (based on the Phone Survey) is observed in a time/area strata, and an unlawfully retained steelhead is observed, then a very large estimate for the number of wild steelhead retained will result. For example, in 1990, I estimated that 120 wild steelhead had been retained. But in the spring season of the 1990 run-year, the Creel Survey observed only 0.094 percent of the harvest in Section 4 of the Clearwater River, but saw one wild steelhead. This one observation accounted for 107 (1/0.094 = 107), of the steelhead estimated to have retained. A similar rare event occurred in fall of 1991 when one steelhead was observed in Section 20 of the Salmon River, and this expanded to 32 fish. For this reason, I believe that estimates for the 1990 and 1991 run-years greatly overestimate the actual number of wild steelhead unlawfully retained by anglers. I attempted to compare estimates of the number of wild steelhead unlawfully retained the department's violation database. Because a unique code for unlawful possession of a wild steelhead was established only a year ago, it is not possible to make a meaningful comparison

RECOMMENDATIONS

Analysis of Phone and Creel Survey data suggests that, on average, 4.25 % of the wild run counted over Lower Granite, or 5.8 % of the wild run entering Idaho is incidentally killed as a result of being caught and released during the conduct of Idaho's sport fishery for unlisted hatchery steelhead. However, there are many reasons to believe that this estimate is biased high. Analysis of harvest rate data indicates that about 5% of the wild run entering Idaho is incidentally killed as a result of being caught and released but this estimate is also likely biased high.

Considering that both estimates are likely biased high, I recommend NMFS use the lower of the two estimates (5%) to bracket the highest likely impact. While no quantitative method is available to correct for the bias in either method, based on IDFG's (1997, 1998) judgment, the lower bound for the likely encounter rate on wild stocks is perhaps half the encounter rate for hatchery stocks, or 2.5%

Unfortunately, we have been unable to identify a cost effective way to eliminate the bias in either estimate. If a cost effective programs can be identified that will provide significant improvement to the estimates, IDFG will seriously consider implementing that research.

Considering the analysis presented in this paper, IDF&G believes that the current adult fishery for unlisted adult steelhead does not jeopardize listed Snake River Steelhead.

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Table 1. The number and composition of steelhead estimated to have crossed over Lower Granite Dam, 1990 - 2000.

	" A" Run Steelhead			"B" Run Steelhead			Total Run		
Year	Wild	Hatchery	Total	Wild	Hatchery	Total	Wild	Hatchery	Total
1990	4,803	25,561	30,364	4,483	22,018	26,501	9,286	47,579	56,865
1991	14,141	69,850	83,991	3,180	11,881	15,061	17,321	81,731	99,052
1992	13,574	83,353	96,927	5,772	25,566	31,338	19,346	108,919	128,265
1993	5,914	35,510	41,424	1,440	16,904	18,344	7,354	52,414	59,768
1994	5,071	32,411	37,483	2,444	7,375	9,819	7,516	39,786	47,302
1995	6,701	63,562	70,263	1,290	7,573	8,863	7,991	71,135	79,126
1996	5,979	67,066	73,045	1,644	12,209	13,853	7,623	79,275	86,898
1997	7,411	66,981	74,392	1,327	10,898	12,225	8,738	77,879	86,617
1998	7,086	43,888	50,974	2,300	17,446	19,747	9,386	61,335	70,721
1999	10,065	54,010	64,076	899	8,835	9,734	10,964	62,846	73,810
2000	17,129	78,140	95,268	2,849	17,044	19,893	19,978	95,183	115,161

Table 2. The estimated number of days fished by licensed Idaho anglers for steelhead, 1990-2000.

Year	Days Fished
1990	138,837
1991	181,914
1992	213,637
1993	206,843
1994	146,744
1995	123,702
1996	136,205
1997	180,112
1998	119,033
1999	173,263
2000	187,811

Table 3. The estimated number of wild steelhead caught and released, number incidentally killed, and proportion of the annual run incidentally killed that was counted over Lower Granite Dam, 1990 - 2000.

Year	Total Wild Run	Number Caught and Released	Number Killed	Proportion of Run Killed
1990	9,286	11,256	563	6.1
1991	17,321	15,718	786	4.5
1992	19,346	14,044	702	3.6
1993	7,354	8,659	433	5.9
1994	7,516	7,297	365	4.9
1995	7,991	6,115	306	3.8
1996	7,623	6,781	339	4.4
1997	8,738	6,597	330	3.8
1998	9,386	4,797	240	2.6
1999	10,964	9,470	473	4.3
2000	19,978	11,587	579	2.9

Table 4. The estimated number of wild steelhead kept by anglers, 1990 - 2000.

Year	Number Kept
1990	120
1991	104
1992	19
1993	3
1994	0
1995	0
1996	9
1997	9
1998	9
1999	4
2000	14

Table 5. The estimated number of "A" and "B" run wild steelhead entering Idaho, that were caught and released, and died, 1990 - 2000.

	Lower Granite Count			No. Entering Idaho			Proportions Entering Idaho		Number Caught and Released			Number Killed	
Run Year	"A " Run	" B" Run	Total	"A" Run	"B" Run	Total	"A" Run	"B" Run	Total	"A" Run	"B" Run	"A" Run	"B" Run
1990	4,803	4,483	9,286	3,122	4,483	7,605	0.41	0.59	11,256	4,621	6,635	231	332
1991	14,141	3,180	17,321	9,192	3,180	12,372	0.74	0.26	15,718	11,678	4,040	584	202
1992	13,574	5,772	19,346	8,823	5,772	14,595	0.60	0.40	14,044	8,490	5,554	425	278
1993	5,914	1,440	7,354	3,844	1,440	5,284	0.73	0.27	8,659	6,299	2,360	315	118
1994	5,071	2,444	7,516	3,296	2,444	5,741	0.57	0.43	7,297	4,190	3,107	210	155
1995	6,701	1,290	7,991	4,356	1,290	5,646	0.77	0.23	6,115	4,718	1,397	236	70
1996	5,979	1,644	7,623	3,886	1,644	5,530	0.70	0.30	6,781	4,765	2,016	238	101
1997	7,411	1,327	8,738	4,817	1,327	6,144	0.78	0.22	6,597	5,172	1,425	259	71
1998	7,086	2,300	9,386	4,606	2,300	6,906	0.67	0.33	4,797	3,199	1,598	160	80
1999	10,065	899	10,964	6,542	899	7,441	0.88	0.12	9,470	8,326	1,144	416	57
2000	17,129	2,849	19,978	11,134	2,849	13,983	0.80	0.20	11,587	9,226	2,361	461	118

Table 6. The annual harvest rate of steelhead originating from hatcheries supported by the Lower Snake River Compensation Program in Idaho, by run type and age, 1991-1996.

Year	A-I	A-II	B-I	B-II	Average
1996	65.9	69.8	70.0	65.3	67.8
1995	69.3	71.4	81.0	75.2	74.2
1994	69.6	58.2	63.2	68.2	64.8
1993	66.5	73.6		87.0	75.7
1992	70.6	88.6	79.0	68.7	76.7
1991	76.7	66.4	86.9	83.3	78.3
Average	69.8	71.3	76.0	74.6	72.9

Table 7. The proportion of hatchery fish caught, that are kept by Idaho anglers, 1990-2000.

Year	Proportion
1990	0.734
1991	0.742
1992	0.757
1993	0.826
1994	0.744
1995	0.634
1996	0.710
1997	0.724
1998	0.693
1999	0.706
2000	0.682
Average	0.723

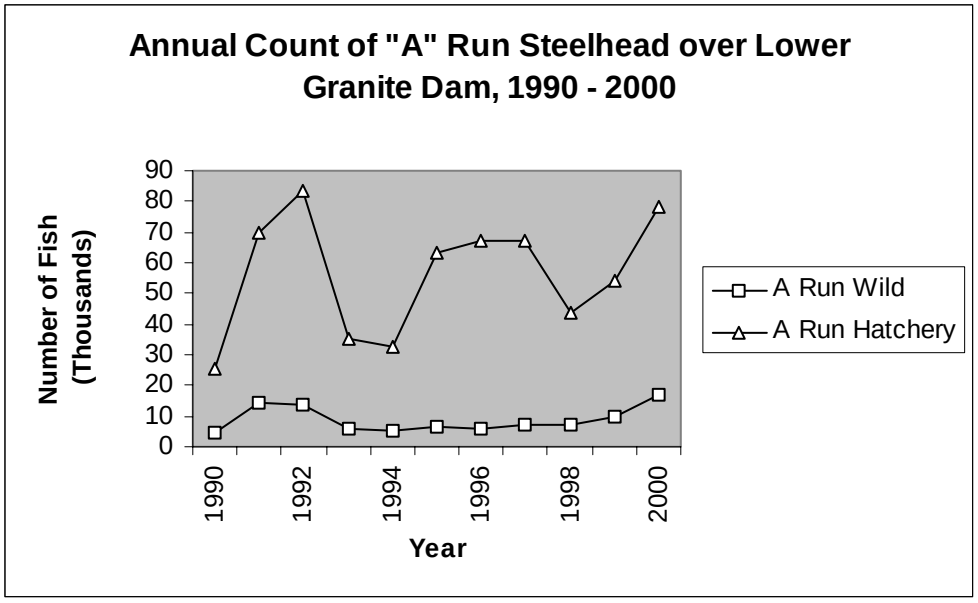

Figure 1. The number of "A" run steelhead counted over Lower Granite Dam, 1990 - 2000.

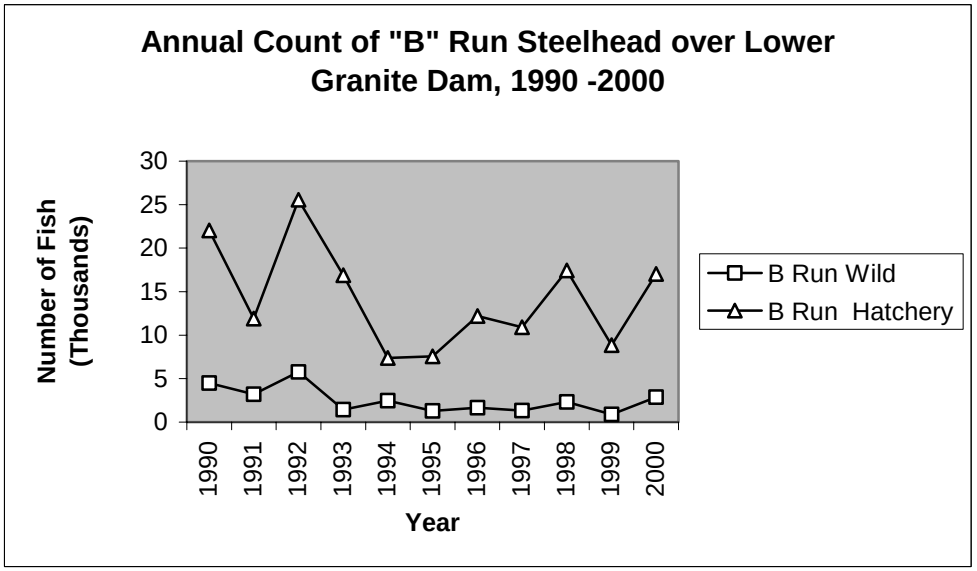

Figure 2. The number of "B" run steelhead counted over Lower Granite Dam, 1990 - 2000.

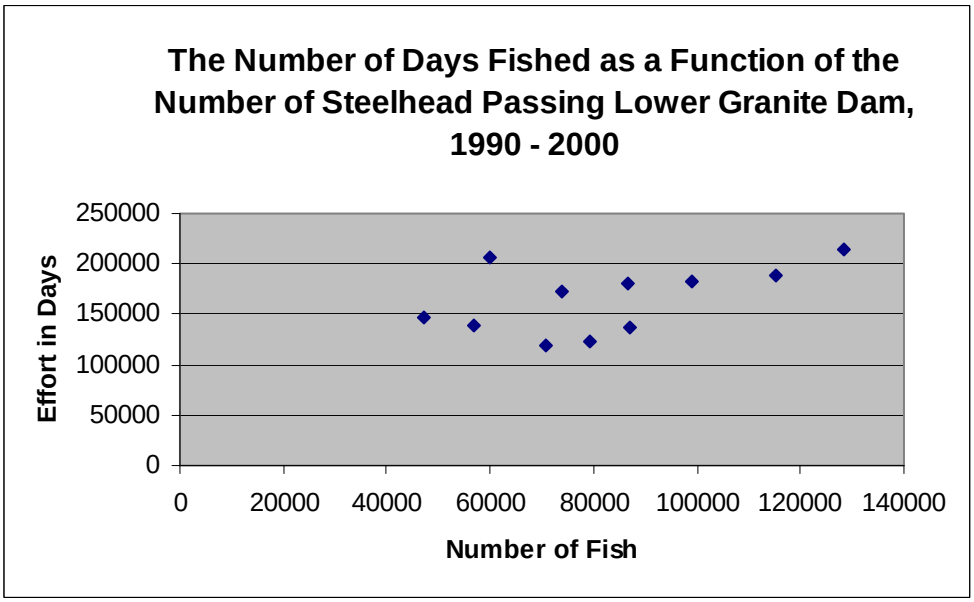

Figure 3. The number of days fished for steelhead in Idaho in relation to the number of steelhead counted over Lower Granite Dam, 1990 - 2000.

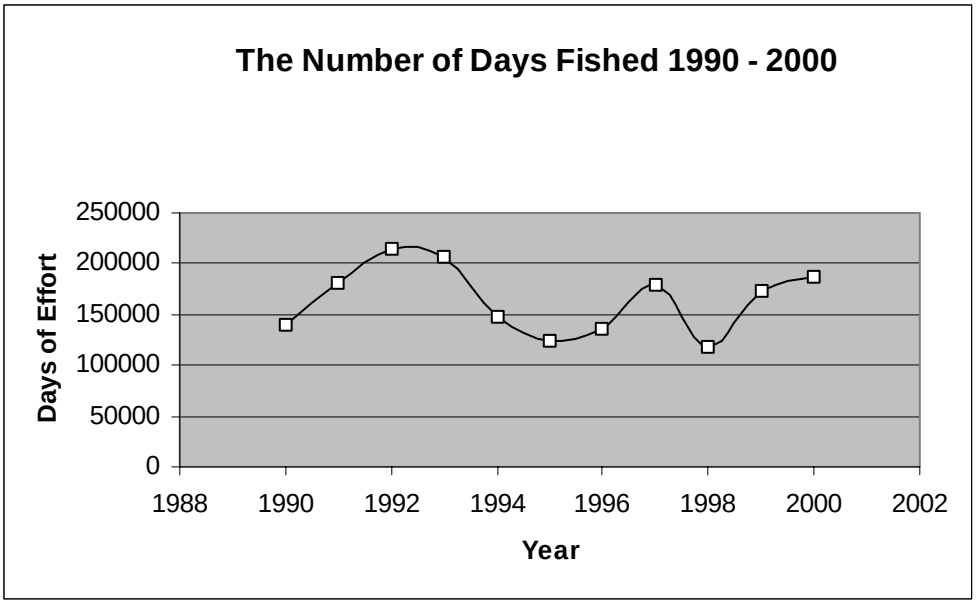

Figure 4. The number of days fished for steelhead in Idaho by year, 1990 - 2000.

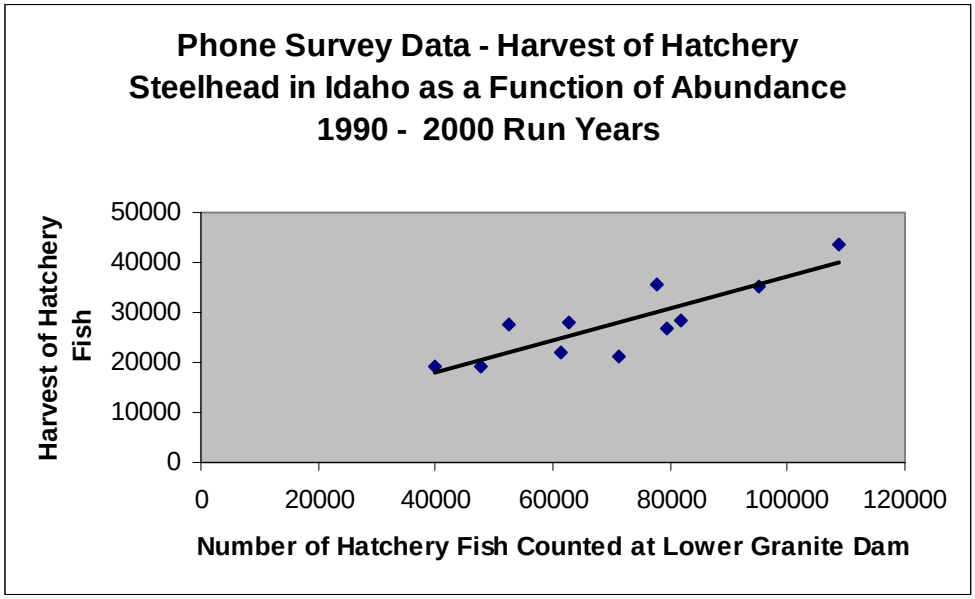

Figure 5. The annual harvest of hatchery steelhead as a function of the number of hatchery steelhead counted over Lower Granite Dam, 1990 - 2000.

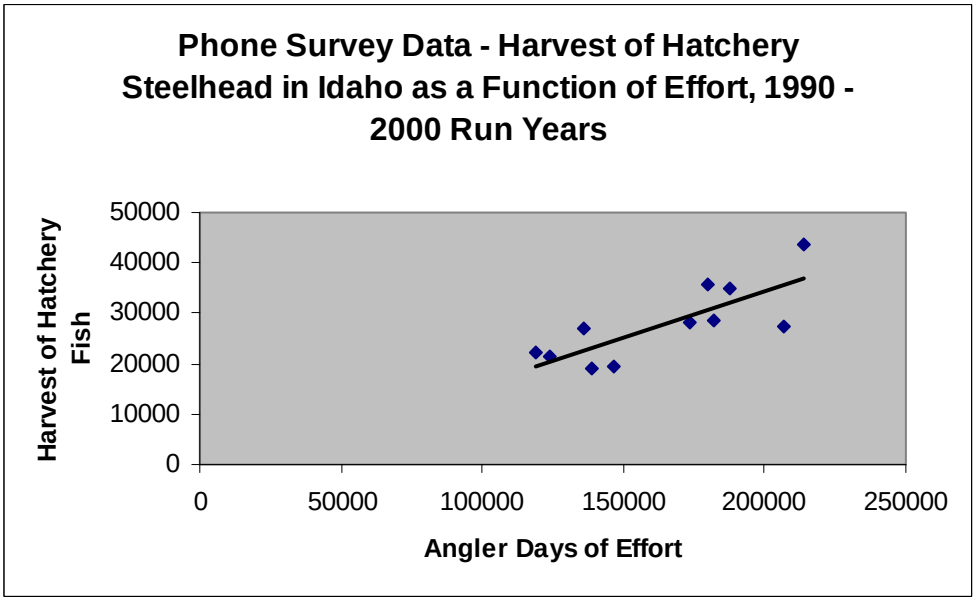

Figure 6. The annual harvest of hatchery steelhead as a function of the number of days fished, 1990 - 2000.

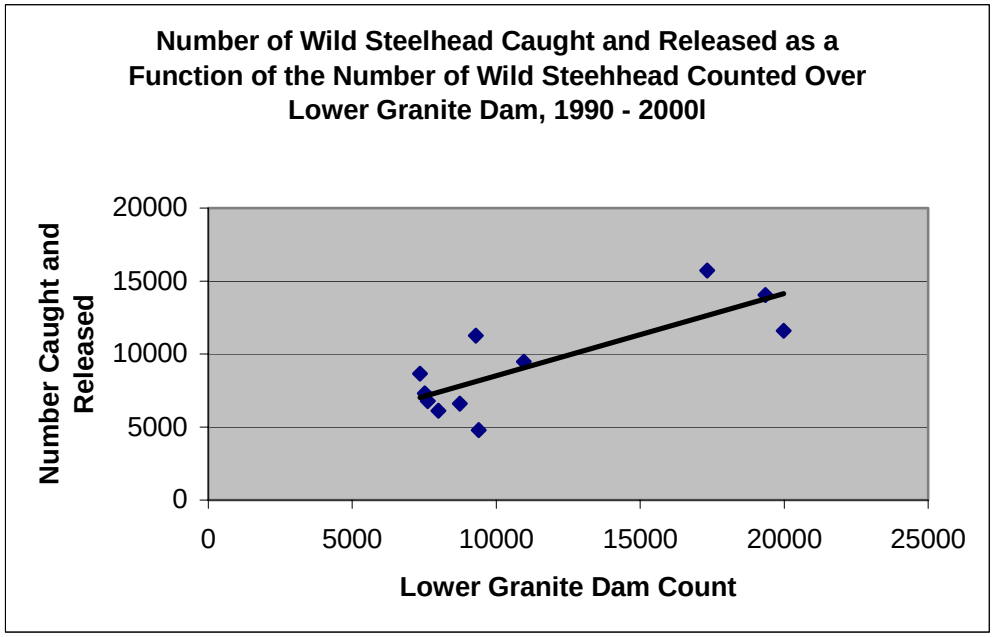

Figure 7. The number wild steelhead caught and released as a function of the number of wild steelhead counted over Lower Granite Dam, 1990 - 2000.

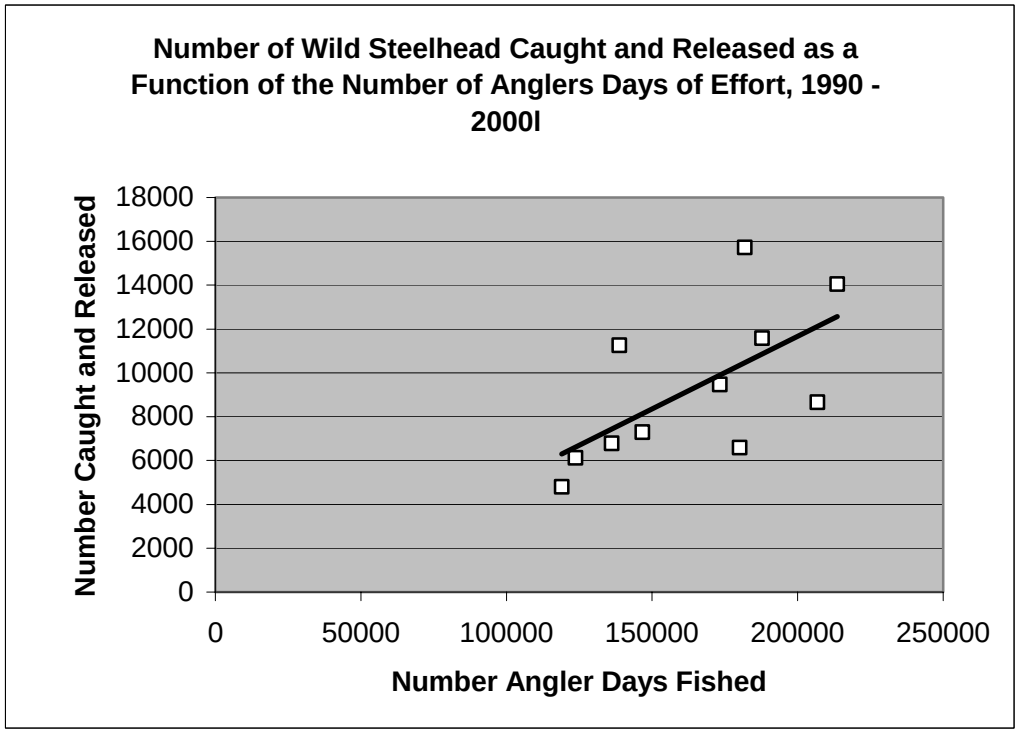

Figure 8. The Number wild steelhead caught and released as a function of the number of angler daysd fished, 1990 - 2000.