Recommendations for Tangle Net release mortality assumptions for Spring Chinook

Prepared by the *U.S. v Oregon* Technical Advisory Committee (TAC)
March 26, 2008

The *U.S. v Oregon* Technical Advisory Committee (TAC) met on March 3, 2008 to review updated information regarding estimates of delayed and immediate mortality of spring Chinook released in commercial fisheries using 4¼-inch "tangle net" gear. The mortality rate estimates were derived from studies conducted during 2001-2003, using a variety of methods and gears. These studies were focused on assessing mortality of spring Chinook only (not steelhead). The results presented to the TAC in 2003 (see TAC memo, 12/23/2003) were preliminary, and were expected to be refined when final data analyses were completed. In February 2008, the TAC was informed that the final data analyses were completed in late 2007. Charmane Ashbrook, the study's principal investigator, presented the final results at the March 3, 2008 TAC meeting and discussed the study and answered questions. The final results of the study for 2001-2002 are currently in peer review and awaiting final approval for journal publication. The authors intend to prepare an additional manuscript summarizing results of the 2003 research. The TAC has prepared a review of the study methods and summarized the relevant aspects and issues associated with the study's design and findings in Appendix A of this memorandum.

Following are key points and recommendations from the TAC regarding estimated mortality of Chinook salmon captured in 4¼"-mesh "tangle net" fishing gear and released in winter and spring commercial fisheries in the lower Columbia River.

- Preliminary findings presented to TAC in 2003 estimated total mortality of fish released following capture in 4¼"-mesh tangle nets to be 18.5%.
    - Mortality estimates were derived from tagging studies using two methods, PIT-tags and jaw tags. The PIT-tag methodology provided much narrower confidence intervals, and was the TAC-preferred method.
    - Two control groups were utilized in the 2003 study; one released at Bonneville Dam and one released downstream closer to where the treatment (net-captured) group was caught and released. Based on control group recovery rates, the Bonneville Dam control group experienced a survival advantage versus the treatment group. TAC elected to utilize the results incorporating the more representative (downstream) control group.
- Final data analyses completed in late 2007 resulted in small changes to recovery and release information from the 2003 PIT-tag test groups.
- Mortality is estimated by comparing the recovery rate of tagged control groups with the recovery rate of tagged treatment groups, thus, changes in release and recovery data analyses alter the estimated mortality rate.
- Using identical methods (tag types, control groups, etc.) as TAC adopted following the presentation of preliminary results in 2003, the estimated mortality for spring Chinook

released from 4¼”-mesh tangle nets is now estimated to be 14.7% (95% CI 12.0% - 17.4%), based upon the updated analyses.

- The updated results represent the final data analyses from this study and no further changes to mortality estimates for spring Chinook in 4¼”-mesh tangle nets based on this study’s results are expected.

- TAC will be reviewing estimated steelhead mortality rates in 4¼”-mesh tangle nets and estimated steelhead and Chinook mortality rates in 8”-mesh nets in the near future.

APPENDIX A

Review of the 2001-2003 study "Evaluate Live Capture Selective Harvest" and evaluation of its use in providing estimates of mortality of released salmon and steelhead in Columbia River commercial net fisheries

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Study Background

The primary goal of this study was to assess the immediate and delayed mortality of spring Chinook captured and released in mainstem lower Columbia River commercial net fisheries. The study was conducted during 2001-2003 and evaluated a number of different net types, including the 4¼-inch tangle net and 8-inch gill net gears currently used in spring commercial salmon fisheries in the lower Columbia. Other mesh sizes evaluated were 3½-inch, 4½-inch, and 5½-inch mesh sizes. The study was intended to mimic actual methods and gear used in the commercial fishery whenever possible, including 150-fathom net length, 45-minute maximum soak times, and use of recovery boxes for lethargic and bleeding fish. However, due to constraints with suitable control groups, the study was conducted upstream of the area where most winter and spring commercial fisheries occur. Steelhead exclusion devices were not evaluated as part of this research.

The basic methodology for estimating mortality of released Chinook was to compare recovery rates of tagged treatment fish (net captured) and tagged control fish (fish removed from the trap at Bonneville Dam). Differences in tag recovery rates between treatment and control fish (Table 1) were assumed to be a result of mortality due to capture and handling in the fishery (with one exception to be discussed later). Although the basic methodology for the study was consistent over the study period, different gears and techniques were used in each year (see following paragraphs) that should be reviewed in order to fully understand the results of the study.

During 2001, 3½-inch, 4½-inch, and 8-inch mesh nets were used to collect fish from April 4 through May 24 downstream of Bonneville Dam (river miles 126-139). Catch of salmonids included 1,372 spring Chinook and 22 steelhead from 224 net sets (drifts). In 2002, fishing occurred during April 1 through May 21 from river mile 125-139 using 4½-inch and 5½-inch mesh nets. Catch of salmonids included 3,162 spring Chinook and 54 steelhead from 376 net sets (drifts).

During 2001-2002, fish were marked with colored jaw tags. The jaw tags provided a visible mark, but proved to be problematic for several reasons; 1) difficulty with visual identification of the jaw tags at passage facilities, 2) problems with the differential visibility of different colored tags, and 3) removal of tags at upriver facilities that led to poor recovery of some tag groups. Overall, only 13% – 19% of the jaw tags were recovered in sport and commercial fisheries, at hatcheries, and on spawning grounds. This poor recovery rate led to large confidence intervals around mortality estimates using the jaw tag test groups.

In 2003, the study evaluated 4¼-inch and 4½-inch nets during the same general timeframe and area as in 2001 and 2002. In 2003, the study also added PIT tags as a marking method (in addition to jaw tags). This addition allowed the use of passive tag detectors at upstream dams

(including Bonneville Dam) to estimate passage of these fish, resulting in much higher tag recovery rates for treatment and control groups. For the 2003 PIT tag groups, tags were recovered at upstream dams at rates of 80% – 98%, and as a result, statistical confidence limits for these groups are very narrow. Additionally, point estimates generated from the PIT tag method fell within the bounds of those generated from jaw tag methods. Due to concerns that treatment fish were being exposed to additional sources of mortality than the control groups (e.g. pinniped losses, sport fishing, and dam passage) during migration from the fishing area to Bonneville Dam (where control groups were collected and released), the 2003 study incorporated an additional control group. One control group was released into the fish trap at Bonneville Dam as in 2001-2002, and the additional control group was transported back downstream to the fishing area prior to release, and was thus exposed to conditions more similar to the treatment groups. A preliminary analysis of the relative survival of the two control groups confirmed that the treatment groups were likely being exposed to additional mortality not related to effects of the fishing gear. Based on the differential survival of the two control groups, the TAC agreed that the control group released at Bonneville Dam had a survival advantage that the downstream control and treatment groups did not have. The TAC concluded that the mortality rate based on the relationship between the downstream control group and the treatment group was likely more accurate and best represented the mortality attributable to the fishing gear (see TAC memo, 12/23/2003). A correction factor using the differential mortality between the two control groups was applied to the mortality rates previously developed for each of the gears tested, including 8-inch mesh (which was evaluated only in 2001).

The survival of treatment groups is scaled to that of control groups by dividing the recovery rate of the treatment group by the recovery rate of the control group. The preliminary analysis conducted in 2003 using combined results for 4¼-inch and 4½-inch mesh and the downstream control group led to the 18.5% mortality rate estimate that has been used since 2004 (Table 1; treatment recovery rate = 79.5%, control recovery = 97.6%, 79.5/97.6=81.5% survival, or 18.5% mortality). This method assumes that differences in survival between the two groups is due only to the treatment effect (the tangle net fishery in this case), and scales the recovery rates of tagged treatment fish to those of tagged control fish, which are assumed to have zero mortality due to treatment effects.

Any changes in the ratio of tag recovery rates between treatment and control groups will affect the estimated mortality rate. The final analysis of the 2003 PIT tag data by Ashbrook utilizes more releases of tagged control fish, and more recoveries of tagged treatment fish than were available in the preliminary 2003 analysis. This is based on updating and finalizing the study's PIT tag data stored in the PTAGIS database managed by the Pacific States Marine Fishery Commission (http://www.ptagis.org). These changes to the tag recovery rates for both groups resulted in the changes to estimated mortality presented to the TAC on March 3, 2008 (Table 2).

Table 1. Comparison of recovery rates of jaw tags and PIT tags, 2003 preliminary results.

Group	Jaw Tag % Recovery	PIT Tag % Recovery
Upstream control	19.2%	97.6%
Downstream control	16.6%	95.6%
Treatment releases	13.4%	79.5%

Table 2. 2003 PIT tag survival estimates for spring Chinook. Analysis updated in late 2007 (values from preliminary 2003 analysis in parentheses).

Group	Percent Survival	95% CI
Tangle Net versus upstream control (not adjusted for non-treatment method mortality sources)	84.4 (79.8)	81.8-87.0
Tangle Net versus downstream control (treatment group not adjusted for immediate mortalities due to pinniped predation)	**85.3 (81.5)**	**82.6-88.0**
Tangle Net versus downstream control (treatment group adjusted for immediate mortalities due to pinniped predation)	87.2 (NA)	84.5-89.8

Discussion

In December 2003, the TAC reviewed the study and concluded that a study design incorporating a downstream control group and PIT tags as the marking technique was most representative of the actual fishery and produced a survival estimate with narrow confidence intervals that was within the bounds of estimates generated using the jaw tag methods. The preliminary mortality rate point estimate for this combination of methods was 18.5%, with a 95% confidence interval of 15.8% – 21.3%. Based upon final tag recovery data for the treatment group (not adjusted for immediate sea lion mortalities) and the downstream control group, the final mortality rate point estimate is 14.7%, with a 95% confidence interval of 12.0% – 17.4%. The final mortality rate point estimate using the downstream control group and a treatment group with immediate pinniped mortalities removed is 12.8%. At the March 3, 2008 meeting, the TAC members agreed to recommend that managers use the mortality rate estimate of 14.7% because it is consistent with the methodology used to estimate the preliminary tangle net mortality rate in 2003, and because it incorporates some pinniped predation mortality that could be expected in the actual fishery, and thus makes the mortality estimate somewhat conservative.

There are at least two substantial follow up items resulting from this final analysis that the TAC will need to review in the coming months. First, 8-inch mesh gill nets were only evaluated in 2001 using jaw tags and an upstream control group. This gear was not evaluated using PIT tags and the preferred downstream control group. Because of this, the TAC used the relationship between mortality rates of upstream and downstream control groups identified in December 2003 to adjust the mortality rate calculated for 8-inch mesh gear. Repeating this exercise based on the latest updated relationship between upstream and downstream control groups may change our recommendation regarding the appropriate mortality rate estimate for 8-inch mesh gear if the relationship between the two control types has changed with the additional PIT tag recovery data.

Secondly, the 2001-2003 study was unable to estimate immediate or delayed mortality rates for steelhead because sample sizes of captured steelhead were small and because the study lacked a suitable steelhead control group. The methodology of the study was simply not intended to estimate steelhead survival and the results cannot be used to directly estimate steelhead mortality. In December 2003, the TAC reviewed the study and various steelhead data sets to try to interpolate mortality of steelhead using some of the Chinook results. This estimate was based upon the assumption that if steelhead were captured in similar ways (physical capture method –

gilled, wedged, tangled, etc.) and in the same proportions as Chinook, then they would be expected to have a similar mortality rate. To determine this, various morphological measurements of both hatchery and wild steelhead were collected and compared to different mesh sizes to determine expected rates of each physical capture method. Physical capture methods of spring Chinook observed during onboard monitoring were also summarized for comparison. Based on this analysis, the TAC concluded that the majority of steelhead would be large enough to roughly match Chinook physical capture profiles in 4¼-inch mesh nets, with the majority of each species expected to be captured primarily by tangling around the head and mouth. Thus, the 18.5% rate calculated for spring Chinook was applied to steelhead caught with tangle nets as well. The TAC also recognized that winter steelhead encountered in the fishery migrate shorter distances and spawn sooner than Chinook, meaning this mortality rate estimate may be conservative.

Since 2003, the agencies' onboard observation program has collected a large amount of data, including physical capture methods of Chinook and steelhead encountered in mainstem Columbia River commercial fisheries. A preliminary review of this data indicates that the physical capture methods of steelhead and Chinook in tangle nets are not as similar as previously assumed. Although tangling is the predominant capture method for both species, the average frequency of capture by tangling for steelhead may be considerably lower than the rate observed for Chinook. Capture by gilling appears to be more prevalent for steelhead than Chinook, but the frequency of wedging seems similar for both species. Gilling rates are the most important indicator of mortality in net fisheries because higher gilling rates typically equate to higher mortality. Considering the updated information on mortality of spring Chinook captured in tangle nets and observed physical capture method profiles for steelhead, the TAC intends to review the mortality rates assumed for steelhead in the near future.

TAC Recommendations

The TAC is recommending that the fishery managers use 14.7% as the release mortality rate for spring Chinook captured in 4¼-inch tangle nets beginning with the 2008 spring Chinook fisheries. The TAC also recommends that the release mortality rate for large mesh gears (8-inch or greater) and for steelhead remain unchanged at this time. During the course of 2008 TAC will conduct a detailed review of steelhead and spring Chinook mortalities rates associated with use of large mesh gear and on steelhead mortalities rates associated with use of tanglenet gear.,.

References

LeFleur, C. 2003. Recommendation for tangle net mortality rate. Memorandum to Bill Tweit and Steve King – Compact representatives, from *U.S. v Oregon* Technical Advisory Committee Chair. December 23, 2003.