MEMORANDUM FOR: F/NWR – Bob Turner

FROM: F/NWR2 – Larrie LaVoy

DATE: February 14, 2011

SUBJECT: Report on Task F from the 2010 Lower Columbia Chinook Harvest Biological Opinion

The 2010 biological opinion (opinion) on the Effects of the Pacific Coast Salmon Plan on Lower Columbia River (LCR) Chinook applied to proposed fisheries in 2010 and 2011 (NMFS 2010a). The opinion set the total exploitation rate limit on LCR tule Chinook in 2010 at 38%; the exploitation rate limit for 2011 was set at 36%, but may increase to 37% if certain tasks are completed that reduce uncertainties related to recovery. The opinion included a list of tasks designed to accelerate recovery by identifying and promoting actions that will benefit LCR tule Chinook populations. If the tasks are completed satisfactorily, NMFS will clarify through it 2011 preseason guidance to the Pacific Fishery Management Council that the total exploitation rate limit in 2011 is 37% rather than 36%. Tasks A through H are listed in the conservation recommendations section of the opinion. Task F read as follows:

Task F: Options for implementing mark selective fisheries
Report should include analysis of the feasibility of mark selective fisheries, the magnitude of differential harvest impacts to marked and unmarked fish and the relative benefits of efforts to reduce the harvest mortality to natural origin fish and reduce the proportion of hatchery fish on the spawning grounds.

The attached report responds to Task F and has been written and reviewed by the Task F work group. The report includes: 1) discussion of the status of fishery modeling tools for mark selective fisheries, 2) an example of the effects on exploitation rates and escapements of hatchery and natural tule Chinook under varying levels of mark selective fisheries, 3) an overview of recent and future studies evaluating alternative gears for commercial fisheries in the lower Columbia River, and 4) some key considerations and issues regarding further implementation of mark selective fishery regulations in ocean and river fisheries.

Contingency Actions for the 2010 Biological Opinion on the Effects of the Pacific Coast Salmon Plan on Lower Columbia River Chinook—Task F

February 11, 2011

TASK F: "NMFS will produce or receive a report that considers options for implementing mark selective fisheries. The report should include an analysis of the feasibility of mark selective fisheries, the magnitude of differential harvest impacts to marked and unmarked fish, and the relative benefits of efforts to reduce the harvest mortality to natural origin fish and reduce the proportion of hatchery fish on the spawning grounds. The report should also provide a schedule for assessing selective fishing gear and mortality rates of released fish."

BACKGROUND

West coast salmon fisheries have evolved using time, area, and gear configurations to select towards maximizing the catch of the more valuable and abundant species and stocks. Selective fisheries using the adipose fin clip mark were first used to identify hatchery steelhead in the recreational fishery beginning in the mid-1980's. In 1998, adipose mark selective fishery (MSF) regulations were implemented in the ocean recreational coho fishery by the Pacific Fishery Management Council (Council). Since 1999, the non-Indian recreational and commercial coho fisheries on the Oregon and Washington coasts have been almost exclusively MSFs. Ocean Chinook MSF fisheries started with the 2003 summer recreational fishery in the Strait of Juan de Fuca and have since broadened to most all areas and time periods in Puget Sound marine areas. In 2010, the first Chinook MSF in the ocean occurred during the June recreational fishery from Cape Falcon Oregon to the U.S. Canada border. MSF for spring Chinook have been in effect in the lower Columbia River since 2001 in the recreational fishery and 2002 in the commercial fishery. The purpose of MSF regulations has been to provide a greater harvest of surplus stocks and increased fishing opportunity (season length) in recreational fisheries for a given fishery impact limit on key wild stock(s). A benefit of MSF regulations and the higher harvest of hatchery fish is the reduction of hatchery fish that return to rivers and reproduce with wild stocks in natural spawning areas.

The Lower Columbia River (LCR) Chinook Evolutionarily Significant Unit (ESU) is one of several ESUs that have been the focus of intensive Endangered Species Act (ESA) recovery planning efforts in Washington and Oregon in recent years. To complement recovery planning efforts, NOAA Fisheries, the states, and others, including the Hatchery and Scientific Review Group (HSRG), have provided additional analyses with particular attention to the lower Columbia natural tule (LCN) component of the ESU. Management actions taken during recent

years have been described by NOAA Fisheries as a transitional strategy and annual exploitation rate ceilings have been reduced. In the NMFS guidance to the Council regarding actions necessary to protect species listed under the ESA, the total fishery exploitation limit on LCN Chinook was 65% prior to 2002, 49% in 2002-06, 42% in 2007, 41% in 2008, and 38% in 2009 and 2010. The NOAA Fisheries guidance letter to the Council dated March 2, 2010, set a total exploitation rate limit for LCN's of 36% in 2011; however, if certain actions identified in the letter are completed then the exploitation rate ceiling could be 37% in 2011. This report addresses one of the actions, Task F, associated with options for implementation of MSF regulations.

MODELING TOOLS

A variety of fishery assessment and recovery planning tools have been developed that can incorporate MSFs and analyze their differential effect on unmarked and marked components of a stock. Annual management of west coast salmon fisheries rely on two models: Chinook Model used for U.S. and Canada fisheries by the Pacific Salmon Commission (PSC) and the Fishery Regulation Assessment Model (FRAM) used by the Council for federal waters and the state and tribal co-managers for state waters. The PSC Chinook Model does not have the ability to model MSF's whereas the FRAM is configured to keep separate accounting of impacts on marked and unmarked components of a stock. The Chinook Technical Committee (CTC) of the PSC oversees development and modification of the Chinook Model. The FRAM has a broader base of model oversight including the Coho Technical Committee of the PSC, the Model Evaluation Workgroup (MEW) and Salmon Technical Team (STT) of the Council, and various regional co-manager technical staff groups. In addition to these models, there are numerous harvest models that are specifically developed to assess river and/or terminal area fisheries.

Several recovery planning type models have been developed that can incorporate MSF effects. One of these early models was the All H Analyzer (AHA) developed by MOBRAND—Jones and Stokes for the HSRG. The Species Life-Cycle Assessment Modules (SLAM) developed by Paul McElhaney and others at the Northwest Fisheries Science Center (NWFSC) is being used to assess recovery actions for LCNs. Although these models are not used during annual fishery assessment processes, they provide another tool that can be used to assess effects of MSFs on escapements and recovery projections.

MSF FISHERY SCENARIO MODELING

MSF ocean fishery scenarios were analyzed with the FRAM. The scenarios cover implementation of MSF's in stages in the Council non-Indian fisheries North of Cape Falcon. Mainstem lower Columbia commercial and recreational fisheries were analyzed using the Columbia River fall Chinook model. River-return harvest rates for marked and unmarked lower Columbia tule Chinook were provided by the Columbia River harvest managers. A variety of MSF regulations in recreational and commercial net fisheries were analyzed, including estimates using alternative gears that potentially provide high survival for released fish (Attachment A). The ocean fishery impact estimates from FRAM were combined with the harvest rate estimates

from the Columbia River fall Chinook model to produce a total exploitation rate (ER) for the marked and unmarked tule component of LCR Chinook.

The effects of MSF regulations depends on a variety of factors including: 1) abundance of marked and unmarked fish available in a fishery, 2) the different contribution rates of each stock in a fishery or to a specific gear type, 3) fishing effort, and 4) season length or quota fishery structure. Several MSF scenarios were run in FRAM covering a mix of stock abundances and marking rates and fishing season structure and implementation of MSF regulations. Modeling results for MSF scenarios are also further constrained by escapement goals (e.g. hatchery brood stock needs), harvest sharing expectations and maximum allowable impacts to listed species that were not modified during this modeling exercise.

RETROSPECTIVE EXAMPLE USING FRAM AND IN-RIVER HARVEST MODEL

The example presented below uses the 2010 preseason FRAM run from the Council as a base for showing a relative perspective on how the ER on marked and unmarked tule Chinook can change with incremental increases in MSF regulations. Table 1 contains the LCN exploitation rates for 2010 and the 2008-2010 average modeled with two abundance levels of lower Columbia River hatchery tule Chinook (LRH). MSF parameters used in the scenario modeling are shown in Table 2. Table 3 shows LCN ERs under different MSF scenarios in ocean and river fisheries. The LCN ER in the river fisheries declines by an estimated 60% (five percentage points) from about 8% under the current regulations without MSFs to about 3% under implementation of MSFs including alternative gear usage during a portion of the fall season (early/mid August and September) by the commercial fleet. Similarly, the LCN ER in the Council fisheries declines by about 27% (17% to 12%) when MSFs regulations were applied to the non-Indian troll and recreational fisheries North of Cape Falcon. MSF's are not likely to occur in other ocean fisheries in any significant manner in the near future and were not modeled for other areas. In this example, which could be considered one scenario for implementation of MSFs in the non-Indian ocean fisheries North of Cape Falcon and the use of alternative gear in the river commercial fisheries, the LCN ER over all fisheries would be reduced by about 23% (39% to 30%) from the ER under the current season structure. This model run used the same landed catch quotas as modeled for the preseason run except that the non-Indian fisheries North of Cape Falcon were modeled as MSFs, hence, the legally retainable fish must be adipose marked by regulation rules. The differential exploitation rates for marked and unmarked LRH Chinook are shown in Table 4. Under this scenario for implementation of MSFs in the non-Indian ocean and river fisheries, the exploitation rate ratio between marked and unmarked LRH Chinook approaches 1.8:1 or in other words if the unmarked ER was 35% then the corresponding marked ER could be about 62%, provided there are no other limiting factors to the extent of MSFs affecting LRH or other stocks. If MSFs were implemented in non-Indian fisheries in the ocean and river fisheries with current gear, the differential exploitation rate ratio would be about 1.4:1 (or a marked ER of about 50% if unmarked ER was 35%). Table 4 also shows the escapement after all fisheries for marked and unmarked LCN and LRH Chinook under different MSF scenarios. Unmarked Chinook escapement is generally stable across the scenarios but marked

escapement declines dramatically as the MSF level shifts from current to implementation with alternative gear in the lower Columbia River.

It should be noted this modeling exercise could not account for all factors associated with stepped implementation of MSF, especially regarding the river fisheries. Many assumptions about mortality rates, catch efficiency, annual variability in stock composition, etc. were made because specific information for all the gears and fisheries considered is not available. Other issues such as the potential for changes in angler participation were not modeled. For instance, the differential ER estimate does not account for sequential marked removals from one fishery to the next. Under full implementation, the mark rates of the catch in later (in-river) fisheries will be lower than what was modeled due to removal of hatchery fish in earlier fisheries. The cumulative effect could be substantial for those fisheries occurring latest in the run, and therefore the differential ER could be less than estimated. The modeling exercise did not attempt to address alternatives where commercial MSFs were expanded which would require additional wild impacts and therefore reduce the differential ER between marked and unmarked populations. Alternative harvest scenarios where certain fisheries (eg. in-river commercial) would operate in different times and areas, and thereby have a different ratio of marked to unmarked fish, were also not addressed.

The modeling results of the aforementioned MSF implementation scenario suggest that it is likely that additional measures would need to be taken to alleviate the stray hatchery origin Chinook in the natural spawning areas, especially for those tributaries with hatchery production facilities within or nearby; however, that conclusion is driven by the assumptions in the model that view future fisheries through the current day lens. The true value or MSF's, especially in the lower Columbia River commercial fishery, will require additional data to effectively evaluate. Testing of alternative commercial fishing gears in the lower Columbia River is beginning and results of data collected during the next several years will provide insight regarding the real effectiveness of MSF commercial fisheries in the lower Columbia River. To that end, Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW) have initiated studies to evaluate the feasibility of implementing new commercial MSFs in the lower Columbia River. Data collected during these studies will be vital to evaluating the effectiveness of alternative gears in assisting in recovery of listed species and supporting a sustainable commercial fishery in the lower Columbia River. It is expected that a multi-pronged strategy will be required to achieve recovery of listed fall Chinook in the lower Columbia River. To that end WDFW has implemented other methods of reducing the proportion of hatchery origin spawners (pHOS) on spawning grounds, as described in Task E.

ALTERNATIVE GEAR STUDY FOR COLUMBIA RIVER COMMERCIAL FISHERIES

In 2009, WDFW and ODFW initiated commercial selective gear implementation projects for fall fisheries in the lower Columbia River which included testing a purse seine, beach seine, trap net, and tangle nets. These programs were expanded in 2010 to include more gear, a broader study period, and an evaluation of short term handling mortality during the first 24-48 hours after

capture. Alternative gear research is on-going and will focus on investigating best handling techniques and associated release mortality rates for different gears. In the first two years of the study, the two most effective methods at catching salmon were purse seine and beach seine, based on absolute catch. Conventional salmon trolling gear and fish traps were largely ineffective at catching salmon in the lower Columbia. Short term handling mortality was very low for both types of seine nets with results from the 2010 study suggesting that the immediate mortality rate is 0.1% for both seining methods combined. Tangle nets fished during October show some promise for targeting coho salmon but are not suitable for fall Chinook due to anearlier run timing and associated higher water temperature. So far, seine nets hold the most promise as a viable gear type for fall commercial MSFs, based solely on absolute catch in the test fishery. Consideration of implementation/operation costs, gear-specific mark rates, and other untested gears should be considered when determining the feasibility of alternative gears. It will take some time to reconfigure the commercial fleet to utilize alternative gears that will work under the site specific conditions in the lower Columbia River. Current fishing vessels are best suited for gill/tangle nets and can be easily modified for beach seining, but are not generally suitable for purse seining.

WDFW and ODFW staff are collaborating to evaluate alternative commercial fishing gears and methods that could be effective for use in the lower Columbia River. Development and implementation of MSF's in the lower Columbia River fisheries will be most successful if implemented in a phased approach, as follows:

Pilot Study:

- Conduct initial test fishing to determine if gear warrants further investigation.
- Pilot studies were conducted in 2009 for purse seine, beach seine, trap net, and tangle net.

Feasibility Testing:

- Conduct multi-year (2-3 year) program to determine if gear has potential for use in a commercial fishery in the lower Columbia River.
- Feasibility study was initiated for purse seine, beach seine, trap net, tangle net, and troll gear in 2010.
- Initial results indicate continued testing of purse seine, beach seine, and tangle net. Discontinue testing with floating trap net and in-river trolling.
- Potentially investigate/test other gear types (pound net, fish wheel, etc) or expand to other seasons (summer Chinook and shad).

Long-Term Post Release Survival Study:

- Conduct study to determine long-term post release survival rates for gear types being considered for use in the lower Columbia River commercial fishery.
- Conduct studies to determine long-term post release survival rates (or at a minimum collect data on gear profiles and hooking location) for fall lower Columbia River recreational fisheries.
- WDFW expects to initiate long-term mortality study for purse seines and beach seines beginning in 2011. WDFW will propose a 3-year study to determine long-term mortality rates to be used to implement commercial MSF in the lower Columbia River.

Permit Fisheries:

- Conduct permit fishery to collect data necessary to implement full fleet commercial fishery using alternative gears and methods.
- Permit fishery would extend for a period of 1-2 years following completion of the feasibility testing and depending on the results of the Long-Term Post Release Survival Rate Study.

Full Fleet Fisheries:

- Implement full-fleet commercial fisheries based on results of Permit Fishery and Long-Term Post Release Survival Study.

Planning Process:

Implementation of alternative commercial fishing gears and methods in the lower Columbia River will require an effective planning process that engages the commercial fishery that will implement these gears and methods and the recreational fishing community that will be impacted by these commercial fisheries.

- Establish work group with commercial fishers to address following implementation issues:
    1. Fishing seasons and locations.
    2. Maintaining an economically viable fishery.
        - Conduct economic analysis/review
    3. Restructuring of the commercial fishery, including fleet size and buy-back programs.
    4. Implementation schedule.
- Implement communication plan for recreational fishery to address impact of commercial fisheries utilizing alternative gears and methods on recreational fishing opportunities:
    1. Identify key recreational fishing groups to coordinate with.
    2. Provide results of commercial studies and ongoing implementation efforts.
    3. Address impacts to mainstem Columbia and tributary fisheries.
- Implement discussion and planning processes regarding other issues associated with implementation of a MSF commercial fishery in the lower Columbia River:
    1. Sharing allocations and limitations between tribes plus sport and commercial fisheries.
    2. Escapement goals for tributary basins, including hatchery broodstock needs and natural escapement goals.

MSF IMPLEMENTATION ISSUES

Although simple in concept, the development of MSFs has not been without controversy. Therefore, practical implementation of this tool should consider many factors including the encountered mark rates, stocks impacted, alternative management approaches, benefits for harvest opportunity as well as stock conservation, and loss of management information (Hoffman and Pattillo 2008).

Consistency with Co-management, Council, and PSC Processes

Implementation of MSFs will involve the participation and coordination of a number of agencies and governments along with public partners involved in west coast salmon management. Proposals for MSFs will be integrated into the overall state and tribal co-management process for annual management in ocean and river fisheries. Management responsibilities and reporting needs pertaining to MSFs will follow those as determined during annual co-management, Council, and PSC forums. MSF will require consideration of conservation objectives, sharing agreements with Columbia River treaty tribes, and the socioeconomic values associated with those in fishing related businesses and activities in coastal and river communities.

Status of Fishery Assessment Tools

Currently there are several technical groups that are upgrading and modifying existing ocean fishery models (Chinook Model, FRAM) or developing new approaches/models that provide improved estimates of impacts from MSFs. The Model Improvement workgroup of the CTC is investigating algorithms and processes that would allow for the Chinook Model to assess MSFs.

The MEW and STT from the Council have been reviewing FRAM algorithms to evaluate the extent that multiple encounters of coho within a model time-step might affect the estimate of mortality on unmarked fish. The MEW intends to develop a recommendation on modifications to FRAM that address this issue at the Salmon Methodology Review to the Council's Scientific and Statistical Committee (SSC) in November, 2011. As MSFs increase and become a higher proportion of the total fishery impact on a stock, the potential bias in the estimate of mortality on unmarked fish increases due to the effect of multiple encounters of released fish. At low levels of MSF, the potential bias is small but as MSFs increase the bias is cause for concern if the multiple encounter issue is not satisfactorily addressed in the model algorithms. The SSC stated at the meeting of the Council in November, 2008 that the Chinook FRAM was suitable for modeling MSFs at low intensity and low intensity was provisionally defined as ERs on marked fish that are less than 10% in any one fishery or 30% across all fisheries. During the initial phase-in of MSFs in Chinook fisheries, it is unlikely that the MSFs will reach the level that imposes significant bias in the mortality estimates. As more MSFs are implemented in the future, it is expected that modifications to the models will have been made to account for the multiple encounter issue.

FRAM is also being reviewed by U.S. vs. Washington co-manager technical staff in order to develop a next generation FRAM (or FRAM equivalent) that addresses the multiple encounter issue as well as other modifications that will improve the fishery impact estimates across all fisheries. This version is still in early development and is probably at least a year away from trials but it is being designed with the purpose to assess MSFs at a variety of intensities.

To account for MSFs in the river fisheries, the in-river harvest spreadsheet model should be modified to account for separate unmarked and marked impacts for each of the Columbia River

stock/management units. Although MSFs require more involved tracking of catches, implementing MSFs in the river should not be hindered solely by the status of the in-river harvest model.

Fishery Sampling and Monitoring

Additional fishery sampling and monitoring will be needed for implementation of MSFs. Information gathered during the introductory period for new MSFs are important for comparing observed total fish encountered, fishery mark rates, and regulation compliance to the modeled values used during preseason fishery assessment. In addition to the normal sampling for coded-wire tags and biological data from landed catch, the number of fish encountered and released should be determined. The number of fish encountered and their fin mark status can be determined from expansion from dockside interviews, voluntary log books, on-board observers or test fishing. Mark status of encounters in MSFs can also be estimated from the mark rate observed in adjacent fisheries in time and area that are not under MSF regulation. Generally, there are increased sampling, monitoring, and reporting requirements that must be taken into consideration when MSFs are proposed.

Mark Rate of Encounters in Fishery

There are no MSF implementation rules that set a minimum mark rate for the encountered fish. In order to provide any benefit to the unmarked population, the mark rate of the encounters should be at least as high, if not significantly higher, than the release mortality rate. At higher mark rates for encountered fish, the acceptance of having to release unmarked fish in order to keep only marked fish will depend on the fishing sector or area (recreational, commercial) and the benefits they see in landed catch and/or season length (opportunity) per fishery impact on key wild stocks. Generally, the higher the mark rate of encounters (preferably greater than 50% or at least substantially higher than the release mortality rate), the more acceptable (or less rejected) the fishers are with MSF regulations. However, at extremely high mark rates (>90%) the benefits of MSF diminish and may not offset the additional costs of sampling and monitoring, enforcement, and reporting responsibilities. The mark rate in each specific fishery or gear type, which can differ substantially from the population at large, should also be considered when implementing MSFs. For instance, the mark rate in the mainstem Columbia River fall recreational fishery is much lower than the aggregate population mark rate because this fishery targets upriver bright fall Chinook which have a relatively low mark rate. Implementation of mark-selective regulations for this fishery could result in a significant reduction in kept catch and/or angler satisfaction and participation. The long-term mark rate, which should increase in the near-term due to increased hatchery fin-clipping but may eventually decline if recovery efforts are successful, should also be considered.

Benefits and Costs

The benefits of MSFs towards reducing hatchery surpluses for a given impact limit on LCN ER was presented in the retrospective example. The benefits are dependent on the magnitude of the

MSFs and the accuracy of the estimates of the release mortality associated with MSFs. Landed catch can be less than, the same, or larger under MSF regulations, depending on the fishery. Fishing opportunity/season length should generally be greater. For example, in 2001 and 2002 the July recreational fishery quota for Chinook in Area 5 of the Strait of Juan de Fuca was 2000 fish under a non-MSF regulation. The quota lasted ten days in 2001 and five days in 2002. In 2003, the fishery was converted to MSF with a quota of 3,500 which was approximately equivalent in unmarked Chinook mortalities to a non-MSF quota of 2,000 Chinook. The fishery lasted 30 days in 2003. Based on modeling, the Buoy 10 fishery would likely experience a longer Chinook retention season under mark-selective regulations but the kept catch would be less since the ability to expand the fishery (time and bag limit) cannot overcome the effect of retaining marked fish only. Based on data for 2000-2009 Buoy 10 fisheries (non-MSF regulations), the kept Chinook catch averaged 10,000 fish with a 53:47 tule:bright stock ratio. If MSF regulations were adopted at current estimated mark rates, the kept Chinook catch would average 7,100 fish with an 86:14 tule:bright stock ratio, although the season could likely be extended. Assuming maximum estimated mark rates for all hatchery stocks (including upriver brights), the kept Chinook catch in the Buoy 10 fishery would average 9,000 fish with a 70:30 tule:bright stock ratio

The "dollar" costs associated with MSF include those associated with fishery sampling and monitoring, gear evaluation, additional data compilation and reporting requirements, research and verification of release mortality rates, and model improvements that address issues associated with MSFs. There are also significant costs to the fishing sectors ranging from gear modifications to increased operating costs because of longer time on the water. Angler satisfaction and commercial ex-vessel value, specifically in the Columbia River, could also be affected since the retained Chinook catch composition would shift toward hatchery tule stocks which have considerably less commercial, and in many cases, recreational value.

Fleet and Gear Preparedness

Hook and line fisheries have been operating under MSF regulations in many areas. Recreational fishers in general have been more amenable to MSF regulations because of the benefits they experience in additional opportunity and season length. This may not be the case for fall Columbia River recreational fisheries where tule Chinook quality begins to become an issue (longer season but poorer quality of retained catch). Commercial fishers, on the other hand, tend to dislike MSFs because release mortality rates for commercial gears have generally been higher and they prefer to land the highest number of fish in the shortest amount of time to reduce operating costs and maximize net income.

Alternative gears for the river commercial fisheries will continue to be studied and techniques refined for safe handling and release of fish. The existing in-river commercial fleet will need time to reconfigure vessels, build nets, and convert to alternative gear methods.

HYPOTHETICAL MSF IMPLEMENTATION TIMETABLE

Given the issues discussed above, the following is a hypothetical schedule for a stepped approach for implementation of MSFs. These phase in steps assume that any implementation of MSFs will only occur following the normal annual management discussions during international (PSC), federal (Council), and co-management forums. The phase in steps take into consideration the status of current fishery assessment models to adequately model MSFs and the time needed to modify or upgrade fishing gear that will ensure adequate survival rates of released fish. This schedule does not specifically address issues of how stock specific catch sharing between user groups might affect when or if MSFs are implemented in a fishery or whether certain groups might prefer to "opt-out" of MSFs and accept a smaller catch for equivalent key stock impacts.

Phase I—MSF Potential Now

Propose implementing MSF regulations in non-Indian ocean fisheries North of Cape Falcon equivalent to up to half of the allowable impact on key constraining stock(s) under a non-MSF season structure. Consider MSF regulations for recreational fisheries in the mainstem Columbia River during times and in locations where the benefit to LCN tule stocks out-weigh the issues previously described. Mainstem Columbia River commercial fisheries would fish with conventional gill net gear and would be non-MSF. Alternative gear in river commercial fisheries would continue for research and/or by very limited entry permit (eg. no more than 10 vessels/operators per net type).

Phase II—MSF Potential near-term (3-5yrs)

Propose implementing MSF regulations in most or all of non-Indian ocean fisheries and many of the river recreational fisheries, if benefits out-weigh costs. Although gill net gear would still be used in mainstem Columbia commercial fisheries (non-MSF), the use of alternative gear could increase to pilot fishery level for river commercial fishers that have reconfigured their vessels and gear.

Phase III—MSF Potential far-term (5+yrs)

Propose implementing MSF regulations in most or all of non-Indian ocean fisheries and many of the river recreational fisheries, if benefits out-weigh costs. Although gill net gear would still be used in some mainstem Columbia commercial fisheries (non-MSF), the use of alternative gear would be a much bigger contributor to the overall commercial harvest, assuming implementation issues described above are addressed.

CONCLUSIONS

- MSFs by themselves can produce a differential harvest rate for naturally and hatchery produced fish, which can appreciably help alleviate the imbalance in marked and unmarked tule Chinook returning to escapement areas while providing increased

opportunity/season length in recreational fisheries and higher landed catch per LCN ER impact limit for both recreational and commercial fisheries.

- The differential ER between marked (hatchery) and unmarked (natural) LCR tule Chinook that theoretically can be achieved by MSFs is dampened by the fact that over half of the fishery impacts are in fisheries that are unlikely to become MSFs in the near future (Alaska, Canada, treaty Indian troll, South of Falcon).

- MSFs for LCN Chinook will need to consider total mortality, catch sharing, and escapement of other stocks in order to successfully achieve the differential harvest rate benefits under "full" implementation of MSFs for LCN Chinook.

- It is important to note that the scenarios described in this document were based on 2010 fisheries and used some fairly simple assumptions about the effects of the alternative gears. Each year as the stock mix and abundance changes within a particular fishery, the results of implementing MSF will vary. Assuming the alternative gears are implemented in the commercial fishery, it is likely they will be used in times and areas that are currently closed for commercial fishing. Although, the current management approach for in-river fisheries is avoidance of LCN Chinook, implementation of alternative gears, which would likely be used throughout the run, which would require handling of LCN Chinook, albeit at presumed low release mortality and within impact limits.

- In one retrospective example, with an LCN ER of about 30% and implementation of MSF in non-treaty ocean and river fisheries, the exploitation rate differential between marked and unmarked tule Chinook is about 1.8:1 but this assumes a very effective nearly full-fleet alternative gear fishery in the river. Under full implementation with existing gear, the exploitation rate differential is about 1.4:1 in the combined ocean and river fisheries (or if the ER was 30% on unmarked tule Chinook, the ER on marked tules would be about 42%). Results of this scenario are constrained by inputs assuming that 2010 fishing seasons and harvest constraints would remain in effect. As described previously, this result does account for the cumulative effect of marked removals from consecutive MSFs in the river.

- The Alternative Gear study in the lower Columbia River has identified gear types that effectively can catch fish on a "test fishery" scale with further study and/or limited fleet fisheries needed to determine the effectiveness as the effort increases to a larger ("full fleet") scale.

- Implementation of MSFs in the ocean and river will alter the mix of stocks in the landed catch which has an effect on co-management, fishery sector catch sharing, and economic value (especially river fisheries for "bright" vs. tule Chinook).

- Fishery assessment models (FRAM, In-River, or otherwise) will need to continue to be modified and upgraded to address the additional challenges posed by MSFs and the desirability of tracking differential marked and unmarked harvest and escapements to separate basins.

- Implementation of MSFs will require discussions between state and tribal co-managers regarding sampling, monitoring, release mortality rates and reporting.

- Secure funding sources will be needed for continued development and implementation of MSFs.

- Full potential of lower Columbia River commercial MSF's cannot be determined until additional studies and discussions regarding the implementation of alternative gear types have been completed.

- Achieving the goals of salmon recovery with implementation of MSF in sport and commercial fisheries and alternative gears in the commercial fishery, will require consideration of conservation objectives, sharing agreements with Columbia River treaty tribes, business/marketing plans, social dynamics of the commercial fishing industry, connection to coast wide fisheries and the goals of and effect on the sport fishery.

- Successful implementation of MSF in sport and commercial fisheries and alternative gears in the commercial fishery, to help in meeting conservation objectives will require a dedicated and coordinated effort. It will be important to meet sharing agreements with Columbia River treaty tribes, communicate and involve affected coast wide and in-river fisheries as well as the lower river commercial fishing industry in developing successful implementation strategies.

CITATIONS

Hoffman, A. and P. L. Pattillo. 2008. The practical application of mark-selective fisheries. American Fisheries Society Symposium 49:451-459.

Table 1. Exploitation rate of LCN Chinook for preseason FRAM runs and with lower Columbia hatchery tules (LRH) at 40,000 adults (2010 preseason was 90,600).

	2010		'08-'10 Average	
Fishery	**Preseason**	**LRH at 40K**	**Preseason**	**LRH at 40K**
AK-BC	0.140	0.142	0.145	0.157
Council Total	**0.151**	**0.167**	**0.130**	**0.149**
No. of Falcon	0.136	0.152	0.124	0.144
(treaty troll only)	0.045	0.048	0.052	0.059
So. of Falcon	0.015	0.015	0.005	0.005
Other So. U.S. marine	0.003	0.003	0.003	0.003
River	0.081	0.079	0.079	0.076
So. U.S subtotal	0.235	0.249	0.212	0.228
LCN Total ER	**0.375**	**0.391**	**0.356**	**0.385**
% Reduction in So. U.S. to achieve 0.36	6%	12%	14%	19%

Table 2. Parameter values used to model MSFs in Council and river fisheres

Fishery	Rel. Mort Rate	Unmarked Retention	Marked Release	Gear Drop Off
Ocean/Council				
Sport a/	0.14	0.08	0.13	0.05
Troll	0.26	0.08	0.13	0.05
River				
Sport	0.16	--	--	--
Gill Net	0.60	--	--	--
Alternative Gear	0.06	--	--	--
a/ Rates used for 2010 preseason FRAM.				

Table 3. Exploitation rate on LCN Chinook under different increments of MSF regulations using 2010 FRAM and a low abundance forecast for LRH of 40,000 adults as a base condition.

	2010 w LRH at 40K, River MSF					2010 w/ NT NoF MSF same quota, River MSF; LRH at 40K
Fishery	Preseason	Buoy 10	B-10+mstem Spt	All spt+Net	All spt+alt gear	
AK-BC	0.142	0.142	0.142	0.142	0.142	0.145
Council Total	**0.167**	**0.167**	**0.167**	**0.167**	**0.167**	**0.122**
No. of Falcon	0.152	0.152	0.152	0.152	0.152	0.107
(treaty troll only)	0.048	0.048	0.048	0.048	0.048	0.050
So. of Falcon	0.015	0.015	0.015	0.015	0.015	0.015
Other So. U.S. marine	0.003	0.003	0.003	0.003	0.003	0.003
River	**0.079**	**0.061**	**0.054**	**0.041**	**0.032**	**0.034**
So. U.S subtotal	0.249	0.231	0.224	0.211	0.202	0.158
LCN Total ER	**0.391**	**0.372**	**0.366**	**0.353**	**0.343**	**0.304**
% Reduction in So. U.S. to achieve 0.36	12%	5%	3%	none	none	-17%

Table 4. Exploitation rates on marked and unmarked LRH Chinook at a terminal run forecast of 40,000 under different MSF regulation scenarios.

	2010 w LRH at 40K and 95% MR, River MSF					LRH 40K w/ NT NoF MSF same quota as 2010		
Fishery	**Preseason**	**B10**	**B10+mstem Spt**	**All spt+Net**	**All spt+alt gear**	**Preseason River**	**B10+mstem Spt**	**River Spt+alt gear**
AK-BC Marked	0.121	0.121	0.121	0.121	0.121	0.115	0.115	0.115
Unmarked	0.122	0.122	0.122	0.122	0.122	0.129	0.129	0.129
Council Marked	0.291	0.291	0.291	0.291	0.291	0.342	0.342	0.342
Unmarked	0.280	0.280	0.280	0.280	0.280	0.209	0.209	0.209
Other So. U.S. marine Marked	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Unmarked	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
River Marked	0.067	0.074	0.084	0.084	0.213	0.062	0.077	0.196
Unmarked	0.068	0.052	0.047	0.036	0.027	0.076	0.052	0.030
So. U.S subtotal Marked	0.361	0.368	0.377	0.377	0.507	0.407	0.422	0.542
Unmarked	0.351	0.335	0.330	0.318	0.310	0.288	0.264	0.242
LRH Marked Total ER	**0.482**	**0.489**	**0.499**	**0.499**	**0.628**	**0.523**	**0.538**	**0.657**
LRH Unmarked Total ER	**0.473**	**0.457**	**0.452**	**0.440**	**0.432**	**0.417**	**0.393**	**0.372**
Marked ER/Unmarked ER	**1.02**	**1.07**	**1.10**	**1.13**	**1.45**	**1.25**	**1.37**	**1.77**
LRH + LCN Tule Esc								
Marked	34,642	34,172	33,546	33,546	24,895	33,492	32,432	24,059
Unmarked	4,460	4,596	4,642	4,738	4,808	4,637	4,826	4,999

Appendix A. Description of Columbia River Fall Chinook Modeling

The in-river modeling was conducted by John North (ODFW) and Cindy LeFleur (WDFW). All of the modeling was done using the 2010 preseason Chinook model (MR2010-Final-Preseason). A total of five options were summarized, including the 2010 preseason fishery, with increasing levels of mark-selective fisheries (MSF). Table 1 summarizes the results of these modeling exercises.

Table 1. Numbers of Chinook kept by stock type, exploitation rates and ex-vessel value of five Columbia River fishery options.

Option	Total Kept	Brights Kept	Tules Kept	Marked ER	Unmarked ER	Total Ex-vessel Value [1]	Bright Ex-vessel Value	Tule Ex-vessel Value
Opt. 1	67,762	42,177	25,585	11.5%	11.5%	$2,730,100	$2,458,900	$271,200
Opt. 2	66,159	38,540	27,619	12.7%	8.8%	$2,539,700	$2,246,900	$292,800
Opt. 3	62,543	33,070	29,473	14.3%	7.9%	$2,240,400	$1,928,000	$312,400
Opt. 4	53,596	24,797	28,799	14.3%	6.0%	$1,751,000	$1,445,700	$305,300
Opt. 5	99,860	34,152	65,708	36.4%	4.6%	$2,687,600	$1,991,100	$696,500

1 Ex-vessel value is applied to both sport and commercial fisheries for comparison purposes only.

Description of Options

Option 1. Status Quo. 2010 preseason fisheries.

Option 2. Buoy 10 fishery is MSF and expanded to full season and 2 fish daily limit.

Option 3. Option 2 plus mainstem sport below the Lewis is MSF and expanded to full season and 2 fish daily limit.

Option 4. Option 3 plus early and mid-August commercial fisheries and September target Chinook commercial fishery are MSF.

Option 5. Option 3 plus early and mid-August commercial fisheries and September target Chinook commercial fishery use alternative gear. The harvest rates for the alternative gear fisheries were the same as those in the model, but the scalar was increased until one of the management constraints was reached. For this option, the Oregon hatchery escapement goal was the constraint that was reached first. In the future, the tule production from Big Creek will shift and will be split between Big Creek Hatchery and Youngs Bay – this was not taken into account for this model. There would likely have been a constraint with some of the individual Washington hatchery escapement goals, but the model only shows the total Washington hatchery goal and not hatchery-specific goals.

Modeling Assumptions

- The 2010 Columbia River preseason Chinook model was used for all Options (MR2010-Final-Preseason), and does not account for variability between years.
- Sport and commercial fisheries occurring above the Lewis River were not modified in any of the options because they have limited impact on Lower Columbia natural (LCN) tules. Those fisheries were modeled the same as the Status Quo option.
- Mark rates were based on river mouth returns and were derived from the FRAM output (Coweeman2010FinalMarked.xls and Coweeman2010FinalUnmarked.xls).
- Release Mortality Rates
    - All sport fisheries – 16%
    - Commercial gill net fishery – 60%
    - Commercial alternative gear fishery (seines) – 5%
    - Note that the release mortality rates that were used for this modeling exercise may differ from those that are used when MSF occur in the future
- Ex-vessel value
    - The ex-vessel value was applied to all of the fish harvested for simplicity and comparative purposes, even though a significant portion of the harvest is sport caught fish and would have a different dollar value.
    - Average weight – 21.2 pounds
    - Price per pound for bright Chinook – $2.75 ($58.30 per fish)
    - Price per pound for tule Chinook – $0.50 ($10.60 per fish)
        - Price per pound are 2010 approximates and do not account for inflation or potential for changes in dock-side value resulting from shifts in stock composition under various model options. For instance, doubling of tule landings could result in market saturation.

The 2010 preseason plan for in-river fisheries was developed with fisheries being constrained by LCN tule impacts. Limited sport and commercial fisheries take place downstream of the Lewis River where the majority of the LCN tule production occurs. After mid-September, fisheries are focused in the upper river (above the Lewis River) and targeting on upriver stocks, primarily Upriver Bright (URB) and Mid-Columbia Bright (MCB) Chinook.

The options shown above focus the MSF on the times and areas where LCN tule Chinook are most abundant and are constraining fisheries in 2010. There is uncertainty with Option 5 as the actual harvest rates that can be achieved with the alternative gear have not yet been tested. Based on the initial results of the 2010 study it does appear that some alternative gears, such as beach and purse, seines could be fairly effective at capturing fish. Differences in

implementation/operational costs, catch rates, and gear-specific mark rates were not modeled – whether or not they are as effectively at capturing LCN tule Chinook is yet to be determined.

Table 1 also shows the differences in the stock mix of the catch. With higher mark rates and target fishing on tule stocks, the retained catch and resultant ex-vessel value is weighted to tule Chinook which are a lower value fish. Although the retained catch under Option 5 is nearly 50% greater than Option 1(status quo), the ex-vessel value is slightly less since roughly two-thirds of the harvest is tule stock, which are worth about 20% as much as bright stock Chinook.

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