American Fisheries Society
Western Division

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To: Julie Weeder <Julie.weeder@noaa.gov>

Subject: Review of the 2012 Draft Recovery Plan for Southern Oregon Northern California Coast Evolutionary Significant Unit of Coho Salmon

From: David Ward, President, Western Division of the American Fisheries Society (WDAFS)

I have attached three separate reviews of the subject plan. Because of the size and complexity of the plan, the limited time for reviewing such a substantial document, and the fact that our members all have other commitments, we proceeded along three parallel tracks: independent reviews by the Oregon Chapter of AFS (page 1), California/Nevada Chapter of AFS (page 17), and a subcommittee of the WDAFS Environmental Concerns Committee (page 30). The three reviews arrived with too little time for the subcommittee chair and the WDAFS Executive Committee to synthesize the comments. In addition, such a synthesis might not meet the approval of all three reviewing groups—although there is a good degree of overlap, apparently because some WDAFS members contributed to multiple reviews. For those same reasons, as well as the nature of our comments, we were not able to use your spreadsheet to format our reviews.

We appreciate the opportunity to review the plan, but recommend that reviews of the final plan be allotted at least six months. If you have any questions, please feel free to contact me.

The WDAFS includes 10 Chapters representing Society members residing in the States of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming; U.S. associated entities in the West Pacific Ocean; the Province of British Columbia and the Yukon Territory in Canada; and Mexico. Some 3,000 strong, our Division members represent a tremendous array of fisheries workers involved in all aspects of the fisheries profession."

Oregon AFS Review of the 2012 Draft Recovery Plan for the Southern Oregon Northern California Coast Evolutionary Significant Unit of Coho Salmon (*Oncorhynchus kisutch*)

Introduction

The Southern Oregon Northern California Coast (SONCC) Evolutionary Significant Unit (ESU) of coho salmon (*Oncorhynchus kisutch*) occupies a vast mountainous area straddling the Oregon/California border (p. xviii). The ESU encompasses the Franciscan and Klamath-Siskiyou physiographic provinces that contain three major river basins: Rogue River, Klamath River, and Eel River (FEMAT 1993: V-I-2, 3). Fisheries managers, fishers, and fisheries researchers in this area became aware of local declines of naturally produced coho during the 1970s and1980s. The geographical extent and severity of the declines were not generally known or scientifically accepted until "Salmon at the Crossroads" was published in 1991 and widely distributed (Nehlsen et al. 1991). Portions of the SONCC coho ESU in the Rogue, Elk, Chetco, Pistol, and Sixes rivers were then classified by Nehlsen et al. (1991) as having a high risk of extinction. Severe declines of coho and lack of effective habitat conservation led to the federal listing of SONCC coho as threatened in 1997 (62 FR 24588), with the listing reaffirmed in 2005 (70 FR 37169). A five year review completed in 2011 concluded that the ESU should remain listed as threatened (76 FR 50447). Despite having more than 20 years to halt the decline of coho and restore habitat, recovery of coho has not been achieved nor has substantial progress in this direction been made.

Endangered Species Act status of the SONCC Coho ESU

The Recovery Plan (p. 2-15) states that "[b]ecause the extinction risk of an ESU depends upon the extinction risk of its constituent independent populations (Williams et al. 2008) and the population abundance of most independent populations are below their depensation threshold, *the SONCC coho salmon ESU is at high risk of extinction and is not viable*" (emphasis added). This conclusion is supported with population viability analysis (Chapter 2), a summary of recent coho declines and local extirpations reported in a NMFS status review (p.1-10; NMFS 2011), and data from Williams et al. (2011a). An independent analysis of salmon species status throughout California ranked the SONCC ESU as endangered (Katz et al. 2012: Table 1). In contrast, the Oregon Department of Fish and Wildlife (ODFW) assessment of the Rogue Coho Management Unit disputes the Recovery Plan's high extinction risk rating for Illinois River and Middle Rogue/Applegate independent coho populations (p. 2-17). The ODFW also found the Rogue River portion of the SONCC ESU to not be at risk of extinction (ODFW 2005).

Regardless of the actual extinction risk of interior Rogue Basin coho populations, the dismal situation for the ESU as a whole is not likely to soon change and there is little systematic monitoring of coho in the ESU that could refute the high extinction risk ratings listed in Chapter 2, declines documented by NMFS (2011) and Williams et. al (2011a), and endangered ranking by Katz et al. (2012). The Oregon Chapter of the American Fisheries Society (ORAFS) believes the current status of the SONCC coho ESU puts a huge onus on recovery planning, implementation, and monitoring. Based on the above publications and personal experience in multiple basins, some of our reviewers recommended that the status of SONCC coho salmon be listed as endangered. Therefore, the ORAFS has reviewed the draft *Recovery Plan for the Southern Oregon Northern California Coast Evolutionary Significant Unit of Coho*

(Oncorhynchus kisutch) (referred to simply as the Recovery Plan from here on). The following are our comments and recommendations pertaining to this draft plan.

Chapter 2. Structure, Viability, and Status of the SONCC Coho ESU

Considering the paucity of baseline data available for this ESU, it appears that NMFS used information to the extent of its availability and appropriateness in this chapter of the Recovery Plan. Williams et al. (2006) describes the historical population structure of coho in the SONCC ESU. According to Williams et al. (2006), developing an understanding of historical structure of populations within an ESU is a prerequisite in recovery planning that ultimately results in the development of biological viability criteria for specific populations and population groups (i.e., populations or groups of populations within a ESU). However, Williams et al. (2006) admit their analysis of historical population structure was strongly constrained by the lack of data available for consideration. Because of this lack of data, their determination of historical population structure of SONCC coho ESU was based primarily on a simple conceptual model of spatially dependent demographics of populations considered to be historically present.

Intrinsic Potential Analysis

We recognize that the ESU populations include areas that are extremely data poor and extensive reliance on models is required. While we are not opposed to such modeling, great care should be exercised in their development and application to ensure the results accurately reflect existing conditions. For example, a great deal of the discussion hinges on the Intrinsic Potential (IP) analysis conducted by Williams et al. (2006) and updated in Williams et al. (2008). Both of these documents are NMFS Technical Reports or Memorandum relied upon to split rivers into sub-population management units. They model both potential habitat and population size as a function of modeled habitat. Our concerns about these two sources are:

a. Have they been subject to independent peer review? Questions that a peer review could address include: How valid are these two sources in relatively data poor environments? Does the data used in the analysis support the conclusions?

b. Are they applied consistently across the ESU? For example, the Upper Mainstem Eel River IP analysis includes areas above an impassible barrier at Scott Dam. This would seem to conflict with other areas where IP was not calculated for habitat upstream of impassible dams and barriers (e.g., North Fork Eel River, Middle Rogue/Applegate rivers). Additionally, if Williams et al (2008) concluded that 54 coho must spawn in the Upper Eel River per year to avoid extinction and there have only been coho in the reach in 5 years since the 1940s, how is the population not functionally extinct?

c. With limited funds and staff time to allocate to recovery, it becomes necessary to know where to focus. It would seem that this analysis should be able to focus the Recovery Plan in those areas where populations may truly benefit from action. This does not appear to have occurred in the Recovery Plan.

Viability Criteria

Williams et al. (2008) develop a framework for evaluating the viability of the SONCC ESU employing criteria representing three levels of biological organization: populations, diversity strata, and the ESU as a whole. The report builds on the population structure report (Williams et al. 2006), describing a framework for assessing population and ESU viability for coho in the SONCC ESU.

McElhany et al. (2000) described four characteristics of populations that should be considered when assessing viability: abundance, productivity, diversity, and spatial structure. The approach in Williams et al. (2008) extends the "viable salmonid population" concept of McElhany et al. (2000) to evaluate extinction risk based on the use of five surrogate criteria related to effective population size per generation, population decline, catastrophic decline, spawner density, and influence of hatchery fish. While the ORAFS generally supports the viability criteria presented in Table 2-2 we are curious to know why NMFS decided to deviate from the characteristics presented in McElhany et al. (2000). We recognize these criteria may change as additional information is collected pertaining to the SONCC.

Chapter 3. Stresses and Threats

There are a wide array of stresses and threats that affect SONCC coho at all life history stages. The Recovery Plan has done a relatively good job at identifying these along with their linkage to coho. Based on available information, ORAFS concurs with the limiting factor and threat rankings by population.

Climate Change

Climate change is discussed in detail in Appendix B. We appreciate that NMFS has made an effort to include this in their stressor analysis. Choice of models and application to the stressor analysis is beyond our review capability and we recommend that the appropriate technical expertise be brought to bear on what could be an issue that affects all populations within the ESU.

Klamath River

The NMFS indicates that implementation of the Klamath Basin Restoration Agreement and the Klamath Hydroelectric Settlement Agreement will be a significant step forward in restoring fish populations in the Klamath River (p. 3-58). The ORAFS agrees with this position. Support for implementation for these two agreements was the focus of a February 10, 2012 letter sent to Secretary of the Interior, Ken Salazar by our organization. However, until the Secretary issues a decision relating to implementation of these agreements, they should not be considered binding and their possible effects on Klamath River populations is not guaranteed as the Recovery Plan seems to indicate.

Chapter 4. Conservation and Recovery Goals, Objectives, and Criteria

Biological Recovery Criteria

Table 4-1 includes general recovery objectives and criteria for limiting factor and threat abatement. The viability criteria describe what is needed for the ESU to be viable, but do not prescribe particular criteria for each population. Rather, particular criteria for each population and the best means to meet the viability criteria will be determined by recovery planners. Specific abundance criteria are presented on Table 4-2 and appear to be based on minimum spawning numbers calculated by the IP analysis (see Volume 2). We are concerned that the spawner abundance does not specify a sex ratio; would a return that is 95% single-sex meet the abundance criteria when resulting production would be terribly low? Additionally, the numbers in Table 4-2 do not always match those in Appendix B (e.g., 230 fish for Winchuk River p. 4-5 versus 220 fish in Appendix B p. 14-1). Meanwhile, NMFS indicates that delisting criteria need to be specific and measurable and populations must meet the biological recovery criteria described in Table 4-1 in order for the ESU to be delisted, yet the criteria in Table 4-1 are not specific or measurable. This connection should be clarified in the final Recovery Plan.

The ORAFS agrees that populations need to demonstrate sufficient abundance, productivity, spatial structure, and diversity to reach recovery. We recommend that the Recovery Plan include a schedule for development of population-specific goals and criteria. Additionally, within Table 4-1, the recovery objective for Core and Non-Core 1 populations is that the population growth rate is not negative. This objective is sufficient for populations that have reached abundance recovery objectives, but for populations below abundance recovery objectives, no population growth will delay recovery or hasten extinction.

Chapter 5. Monitoring and Adaptive Management

According to NMFS, the objectives for limiting factor (stresses) and threat abatement are as follows: (1) the limiting factors (stresses) currently affecting SONCC coho have been sufficiently abated in target areas; and, (2) the threats identified at the time of listing, as well as any new threats, have been sufficiently removed or abated in target areas. Target areas are those areas which will produce the numbers of adults or show juvenile occupancy levels needed to meet biological recovery criteria for each population. These target areas have not been identified in the Recovery Plan. Instead, these areas will be identified for each watershed after the comprehensive habitat survey in each watershed occurs. No timeline is provided for conducting the comprehensive habitat survey in each watershed or for identifying target areas. The ORAFS is concerned that implementation of needed recovery actions will be delayed without the setting of specific timelines for studies.

Adaptive Management and Effectiveness Monitoring

Status reviews of SONCC coho will occur every 5 years. Following these status reviews, the existing recovery plan will be reviewed to determine whether the plan should be updated or revised.

Status reviews are required by the ESA but are not true adaptive management. The ORAFS recommends that a clear structured feedback loop from all of the monitoring directly to the Recovery Plan be added to the existing document. This will clarify the connection between all the required monitoring and actual on-the-ground actions designed to result in the recovery of coho.

We have the following additional specific concerns related to monitoring:

1. What science was used to determine the intervals at which monitoring would occur? For example, why was 3 years consecutive monitoring of adults followed by 3 years of no adult monitoring chosen, or why were the 10 and 15 year intervals chosen for habitat monitoring (Table 5-7)?
2. Target areas for threat and stress monitoring have not been determined (p. 5-27). It would seem that for many of the watersheds there exist a variety of local watershed plans and state-wide planning documents that include relatively specific evaluations

of threats and stressors. While some of these are included in the Plans and Assessments sections for each population, were these sources used to identify stressors and threats? Why is substantial additional research needed before target areas can be identified?

3. It is unclear if NMFS is recommending the creation of intensively monitored watersheds (p 5-37) or if these would be a by-product of the monitoring required in the Recovery Plan. This should be clarified in the final Recovery Plan.

Volume 2 – Population Unit Discussions

Because of the extensive nature of Volume 2, we focused our review on watersheds with which reviewers had some familiarity and looked for general themes that could apply to multiple watersheds. A detailed review of the content in Volume 2 was beyond our capability at this time. The Recovery Plan discussions for the following population units were reviewed: Lower Klamath River, Middle Klamath River, Pistol River, Chetco River, and Upper Mainstem Eel River. The following comments are based on review of those sections and consistent themes that seem to be showing up in the discussions.

1. See the previous comments on the IP analysis on which this entire volume relies.
2. Some actions (e.g., develop a grading ordinance, establish TMDLs, educate landowners, California Environmental Quality Act Categorical Exemption for water leasing, incentives for California water code sections, modifying forest practice rules, etc.) are possibly helpful but rely on state or local jurisdictions for development and implementation. It will be virtually impossible to track implementation of these efforts let alone their corresponding effect on coho. If NMFS has an idea of how to correlate these actions to coho recovery in any quantifiable manner that information should be presented in the Recovery Plan.
3. Proposed actions can be divided into four different categories:
    a. Actions that are already being done such as tracking incidental harvest in commercial and recreational fisheries.
    b. Actions that have probably already been completed (either for specific watersheds or in the literature that are applicable to this ESU). These include, for example, habitat typing, barrier assessment, evaluation of cattle grazing on riparian systems, and evaluation of coho use of estuarine habitats.
    c. Actions that could occur. These include actions such as floodplain reconnection, off channel habitat creation, structure placement, riparian plantings, and so forth.
    d. Proposed actions may be very difficult to implement, for example estimating annual infection and mortality rates for *Ceratomyxa shasta* and *Parvicapsula minibicornus.*

While they lack specificity, none of the strategies proposed in the Recovery Plan present novel or untested practices. We encourage NMFS to incorporate local expertise when prioritizing actions within a specific watershed and at the population level to maximize effectiveness while minimizing the need for re-collection of data.

4. We recognize that the ESU is generally data poor, but are concerned that there may be too much emphasis on studies instead of action. For example:
    a. Pistol River spawning and rearing habitat is to be measured first in a comprehensive survey. What is done with the information gathered in the initial survey? Follow-up surveys are recommended once every 15 years on 10% of habitat found in initial survey. What happens if significant changes are documented in year 15? What science supports this 15-year interval?
    b. One action is to evaluate barriers and then remove barriers. The data used in the analysis included barriers information (see Recovery Plan electronic Appendix H). Is this not adequate? Why does data need to be re-collected. Why not simply take the information that's been collected and implement the recommendations?
    c. Other actions require maintenance of US Geological Survey (USGS) flow gages. Is NMFS going to provide funding to support this data collection? This happens to be the third step in a particular hydrology set of actions where the first two seem out of sequence. For example, how can you determine instream flow needs for coho (step 1) without the hourly data (required for collection in step 2) which is collected by the USGS gage (step 3)?
5. Many of the monitoring actions do not have a readily apparent connection back to management actions. For example, in the Upper Eel River one action is to annually estimate the density of Sacramento pikeminnow and identify the status and trends. What happens to this information? An earlier comment of ours focused on adaptive management and this is yet another example of how true adaptive management does not seem to be included in the Recovery Plan in an adequate level of detail.
6. It is generally unclear how a particular stress can be rated very high and yet corresponding threats categorized as high (e.g., Chetco River estuary function and channelization/diking). This process should be clarified so the reader understands the methodology used to make these evaluations.

Overall Recommendations

Hatcheries

Hatchery operations in Oregon and California were influential in the listing of SONCC coho. Three artificial coho propagation programs are included in the SONCC coho ESU: Cole Rivers Hatchery, Trinity River Hatchery, and Iron Gate Hatchery. The NMFS determined these artificially propagated stocks were no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU. Natural populations in the Klamath River, Trinity River, and Rogue River basins remain heavily influenced by hatcheries (Weitkamp et al. 1995; Good et al. 2005). Hatchery practices have altered the genetic composition (Reisenbichler and Rubin 1999; Ford 2002), phenotypic traits (Hard et al. 2000; Kostow 2004) and behavior (Berejikian et al. 1996; Jonsson 1997) of naturally-produced fish in these basins. The influence of the hatchery operations on genetic fitness of naturally-produced coho populations in the Klamath and Trinity rivers is substantial (p. 3-9). Moreover, because the Klamath and Trinity watersheds represent a large proportion of spawning and rearing habitat in this ESU, NMFS concluded that hatchery impacts are significant at the ESU level.

Reforms to hatchery programs were implemented by ODFW in the late 1990s. Hatchery production of coho was discontinued in the Willamette River in 1997 because of concerns of adverse interactions with listed salmon and steelhead. The former hatchery coho population became self-sustaining and now numbers over 20,000 adults (Alsbury 2012). The Cole Rivers Hatchery coho broodstock is of local origin with no out-of-basin stock introductions. This hatchery maintains broodstock and progeny that are genetically and ecologically similar to naturally-produced populations. This status is achieved by incorporating a substantial number of naturally-produced coho into the broodstock annually, with the goal of reducing genetic and ecological risks associated with hatchery fish spawning in the wild and interacting with wild juvenile coho in the Rogue River basin (ODFW 2009).

The commonly held view is that heavy use of local naturally-produced fish in hatchery broodstock will result in hatchery fish that are better adapted to reproduce in the natural environment than hatchery fish from programs where nearly all of the parental stock are of hatchery origin (ISAB 2003; Berejikian and Ford 2004; Araki et al. 2008). Chilcote et al. (2010) calls into question the effectiveness of this path as a means to lessen the impact of hatchery programs on wild populations. Chilcote et al. (2010) found a negative relationship between the reproductive performance in natural, anadromous populations of steelhead trout (*Oncorhynchus mykiss*), coho, and Chinook salmon (*O. tshawytscha*), and the proportion of hatchery fish in the spawning population. Intrinsic productivity declines as the fraction of the hatchery spawners in the natural population increases.

Hatchery programs that use local, naturally-produced fish in the broodstock have some advantages, especially with respect to maintaining genetic lineages; however, from the standpoint of natural recruitment performance it appears that the difference between integrated type and segregated type hatchery fish may be inconsequential. Therefore, we conclude, as did Chilcote (2003) and Nickelson (2003), that under most circumstances the long-term conservation of natural populations is best served by the implementation of measures that minimize the interactions between naturally-produced and hatchery fish.

Straying of hatchery coho is a frequent occurrence in all river systems where hatchery fish are propagated (Reisenbichler and Rubin 1999). For example, straying of hatchery fish in the Klamath Basin is common (p. 3-11). We agree that the concept of the proportion of natural influence (PNI) developed by the Hatchery Science Review Group (HSRG 2004) may be a useful tool for limiting the risks of fitness loss in natural populations due to straying of hatchery fish.

This discussion is pertinent to the Recovery Plan because biological recovery objectives and criteria for SONCC coho include achieving low or moderate hatchery impacts on naturally-produced fish, with a recovery criterion for the proportion of hatchery-origin spawners (pHOS) of less than or equal to 0.10. Sampling strategies for Core Areas with Life Cycle Monitoring (LCM) stations for the initial, intermediate, and delisting phases of recovery monitoring include a goal to estimate natural/hatchery ratio on spawning grounds to determine the degree of hatchery influence on spawners to assess overall genetic diversity using weir counts and spawner surveys. During the intermediate phase of recovery, determining the degree of hatchery influence on spawners to assess overall genetic diversity would also occur for core populations without LCM. To better determine the degree of influence of hatchery programs on natural spawners, we recommend that sampling occur in all core populations, regardless of LCM presence, during initial, intermediate, and delisting phases of recovery.

Recovery criteria also include that all hatcheries affecting SONCC coho have NMFS-approved Hatchery Genetics Management Plans (HGMP) in place and that hatchery effects are within the levels described in the respective HGMP. We support development of HGMPs for every hatchery in the ESU. For populations achieving their recovery return rate, hatchery programs should be managed to minimize the degree of hatchery influence on natural spawners.

Harvest

Significant changes in harvest management have occurred since the late 1980s, resulting in substantial reductions in harvest of SONCC coho. Mark-selective coho retention occurs in the Oregon part of the ESU, while California has a statewide prohibition of coho retention. We continue to support harvest management activities that maintain low impacts from recreational and commercial fisheries on SONCC coho. Marking of all hatchery-produced coho so that they can easily be identified should be a requirement of the recovery plan.

Habitat

Mineral Withdrawal

An increase in gold prices resulted in an increase in gold mining in the ESU. Though California has instituted a suction dredge ban, dredging in Oregon coho streams has increased. For example, the Chetco River was slated for intensive suction dredging, but a Wild and Scenic River designation appears to have resulted in withdrawal of mineral extraction approvals that ended this threat. In general, the federal General Mining Law of 1872 and federal regulations allow placer miners to substantially modify aquatic and riparian habitat along coho streams with relative impunity. Placer mining in some areas of the SONCC ESU could delay coho restoration and recovery. We recommend that the NMFS identify specific streams with high IP and high public land mining claim densities (e.g., Sucker Creek, Althouse Creek, and Galice Creek in the Rogue Basin) and then recommend to BLM that these areas be withdrawn from mineral entry to conserve coho habitat and allow effective restoration.

Minimum Flows for Oregon SONCC Streams

The ODFW applied for instream water rights for fish in numerous streams within the SONCC ESU. The certificated ODFW water rights, however, are often junior water rights and the streams are often depleted of water by more senior water rights holders. We concur with the conclusion that altered hydrologic function is a high or very high limiting factor in 17 of 41 populations throughout the ESU (Table 3-4). We request that NMFS review the recommended monthly minimum flows included in instream water right applications by ODFW and determine if these flows are adequate minimums needed for fish in these streams. We also recommend that in agricultural areas such as the Illinois Valley, Oregon and Scott Valley, California, recovery actions identify securing adequate instream flow for coho as a top priority.

Beaver

Beaver (*Castor canadensis*) ponds provide excellent winter and summer rearing habitat for coho (Reeves et al. 1989; Pollock et al. 2004). Trappers throughout the Pacific Northwest have reduced beaver population to remnant levels. The historic decline in beaver populations is a contributor to lack of floodplain and channel structure. The resulting effect of decreased beaver abundance on coho populations was likely substantial.

The NMFS identifies that floodplain and channel structure is insufficient in every population and that habitat should be reconnected and restored. This includes the recruitment and addition of large wood or other structure to streams. The NMFS indicates that off-channel ponds, wetlands, and side channels should be restored or connected to the channel, possibly by reintroducing beavers.

Information regarding the distribution and abundance of beavers within the SONCC coho ESU is relatively limited (Riverbend Sciences 2011). In general, translocations of beaver are not recommended, unless certain criteria are met (ODFW 2007). Beaver are often unknown to landowners and fisheries managers because beaver often seek secluded off-channel areas for dam building. Because they can be destructive to public and private property, beavers are classified as a predatory species in Oregon and regulations allow private landowners to destroy beavers and their structures without notification to state agencies.

Per the Oregon Coast Coho Conservation Plan for the State of Oregon (ODFW 2007), ODFW committed to:

1. Expanding outreach and education, informal conversations with trappers, landowners, and land managers and informal exploration of alternative damage control methods for private landowners.
2. Developing tools (e.g., maps and incentives) to identify key areas for beaver dams and to help landowners address beaver damage.
3. Evaluating methods to maintain, enhance, or promote beaver dams in areas where they can create or maintain high quality coho rearing habitat.

The intended outcome of these activities is to achieve an increase in beaver dams to create stream complexity and high quality coho rearing habitat.

We agree that it is better to maintain, enhance, or promote beaver dams in areas where they can create or maintain high quality coho rearing habitat and provide technical advice and solutions for landowner conflicts. We recommend that outreach and education to land owners be emphasized in the Recovery Plan for this topic. Funds and technical support are needed to provide fencing for landowners wishing to protect trees and to develop beaver excluders for culverts that also pass migrating adult coho. Identifying prime areas for beaver habitat enhancement and methods to maintain, enhance, or promote beaver dams in areas where they can create or maintain high quality coho rearing habitat should be promoted in the Recovery Plan as a primary goal rather than beaver translocation.

Spawning Ground Surveys

The Recovery Plan should incorporate techniques that have worked well in the ESU and discourage use of those that do not work. A long term data set of coho adult spawning from numerous small streams would provide some scientifically valid feedback for adaptive management (p. 5-19). Long term data sets for Oregon Coastal coho have demonstrated that low road density at the 7^{th} field watershed scale are correlated with higher numbers of coho spawners and "weak rock" geology is correlated with lower coho spawners (Firman et al. 2011). Therefore, we recommend that recommended actions make better use of existing analysis and that more intensive spawning ground surveys and monitoring occur, including in non-core areas.

Unfortunately, relying on state budgets for adult monitoring is not working. The ODFW has discontinued systematic coho spawning counts in the ESU with no plans to resume them. Therefore, we recommend that the NMFS take responsibility to implement standardized coho monitoring, or provide adequate funding of monitoring, using standardized methods (e.g., Adams et al. 2011 and Stevens 2002) so that comparisons and analysis of all coho populations are scientifically valid, regardless of state of origin.

Appropriate Spatial Scale for Habitat Restoration

We agree that the spatial scale for species recovery is the populations delineated in Figure 2-1. Habitat recovery at this scale, however, is problematic because of the large area covered and its inherent heterogeneity over many hundreds of square miles of habitat. We recommend that the fundamental unit for habitat recovery be the 5th field watershed scale and important individual spawning populations be identified at the 6th or 7th field spatial scale for intensive habitat protection/restoration. Analysis in FEMAT (1993), Firman et al. (2011), and Williams et al. (2011b) provides a sound scientific basis for restoration of habitat at smaller spatial scales than the population scales identified. Profiles for each population (Volume 2) are necessary, however, to provide the context for habitat recovery at smaller watershed scales.

Restoration Actions

We suspect that it will be virtually impossible to secure the $3.5 billion predicted in the Recovery Plan as necessary for recovery. This means that difficult decisions will need to be made about which restoration actions will yield the most benefit. There are a variety of coho habitat (e.g. HabRate, HLFM, RIFFLE) and flow-based models that could aid in action prioritization. Model outputs could be number of smolts produced for a suite of restoration activities. A “triage” approach may be required where watersheds that are too impaired or where populations are functionally extinct are overlooked for watersheds that could realistically be restored. An example of this triage approach may exist in the upper Rogue River subbasin where coho are functionally extinct from the urbanized Bear Creek watershed but still relatively abundant in the agricultural and rural Little Butte Creek watershed immediately to the north (ODFW 2004) or in the Upper Mainstem Eel River where coho have been present in only 5 years since the 1940s.

We also recommend constructing accurate spatial critical habitat coverage for the ESU. To our knowledge, one does not exist. We recommend developing this coverage based on the NMFS Technical Review Team IP model, which factors in gradient and valley width, along with a healthy dose of local expertise. This coverage could then be used to further downscale and prioritize restoration actions at the watershed and individual stream level.

As we have seen in other systems (e.g., Sacramento-San Joaquin Delta in California), the billions identified for recovery actions could easily be spent with no measurable returns. We recommend that specific on-the-ground actions be prioritized once baseline data are collected. Too often allocated money appears to go to staff salaries and more research. At some point it is necessary to actually take actions. The risk then becomes that money is wasted because there is no structured priority for implementation or a hierarchical spatial approach based on the spatial partitioning of habitat by coho. Scattering projects over the vast ESU without a science-based strategy and adequate monitoring is not going to yield measurable results that could contribute to recovery. Models, case studies, and expertise exist to upgrade the habitat portions of the Recovery Plan to pinpoint where and what kinds of management would be effective and to establish ordered priorities for effective use of funds. We urge you to work at the identified population level and convene land managers, experts in habitat protection/restoration, and practitioners/technicians to develop a short term emergency recovery plan for decisive actions to develop prioritized actions specific to each population.

Riparian Systems

The Recovery Plan provides no science based quantitative standards for riparian vegetation protection/restoration. Riparian systems are important for stream health, a fact that is hardly disputed anymore. The general actions related to preservation and rehabilitation of riparian systems are a good first step; however, we recommend that a science-based discussion of riparian setbacks and management prescriptions be included in the Recovery Plan.

Key Watersheds

The Recovery Plan does not identify a system of key watersheds or refugia within designated population areas to focus habitat restoration. While the population level analysis is necessary for management of the ESU and likely a generally appropriate level for effectiveness monitoring, the key watershed concept could be incorporated to provide immediate focus of monitoring and restoration activities.

Aquatic Conservation Strategy

Currently the SONCC Coho Plan (p.3-48) only describes the Northwest Forest Plan (NWFP 1994) and its Aquatic Conservation Strategy (ACS) as it applies to federal lands. We recommend that NMFS consider incorporating the ACS and its Standards and Guidelines to a higher degree into the Recovery Plan. Reasons for this recommendation are:

1) Logging and road building has been identified as one of the major factors contributing to the decline of SONCC coho.
2) The NMFS has previously reviewed the NWFP and found it adequate for protecting and restoring the federally listed SONCC coho (NMFS 1997a; NMFS1997b).
3) The NMFS has found both the Oregon Forest Practices Act and California's Anadromous Salmonid Protection Rules to be deficient in protecting and restoring coho habitat (p.1-6).
4) The draft Recovery Plan provides no science-based quantitative standards for riparian vegetation protection/restoration.
5) The draft Recovery Plan fails to identify a system of key watersheds or refugia within designated population areas to focus habitat restoration.
6) Assessments at the population scale (Volume 2) are necessary but the population area is too large to provide adequate technical detail and management needs at 5^{th} field, 6^{th} field and 7^{th} field watershed scales.
7) The ACS is identified as *guidance* for planning purposes on non-federal lands and not intended to be legally binding or "required" (see p.i Disclaimer).

The ACS provides a strategy for implementing recovery actions. It was developed to stabilize and recover imperiled fishes and to work in tandem with recovery efforts for the Northern Spotted Owl (*Strix occidentalis caurina*). The strategy employs several tactics to approach the goal of maintaining the "natural" disturbance regime (Burnett et al. 2003). Land use activities need to be limited or excluded in those parts of the watershed prone to instability. The distribution of land use activities, such as timber harvest or roads, must minimize increases in peak streamflows and sediment. Headwater riparian areas need to be protected, so that when debris slides and debris flows occur they contain coarse woody debris and boulders necessary for creating habitat farther downstream. Riparian areas along larger channels need protection to limit bank erosion, ensure an adequate and continuous supply of large wood to channels, and provide shade and microclimate protection. Watersheds currently containing the best habitat or those with the greatest potential for recovery should receive increased protection and receive highest priority for restoration. The ACS is implemented with four integral components: Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration. These components are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems to meet ACS Objectives. A similar approach could be taken to recovery planning for SONCC coho.

Editorial Comments

The following specific editorial issues were observed during our review of the draft Recovery Plan:

1. Table 3-4 (p. 3-6): Missing definition for superscript 1 found within body of table.
2. In the Volume 2 figures at the beginning of each section that present the population distribution the captions on the population maps say that the gray areas represent private lands, but the legend in the figures indicates that a reddish color indicates private lands.
3. To facilitate ease of access, remove the bookmarks to Volume 1 in the Volume 2 pdf file and put the Volume 1 bookmarks into Volume 1.

Conclusions

ORAFS congratulates NMFS on assembling and analyzing a large amount of data spanning a wide geographic area. We recommend strengthening several sections before publication of the final Recovery Plan. It appears that a relatively comprehensive review of available information was used in chapters dealing with Structure, Viability and Status of the SONCC Coho; Conservation and Recovery Goals, Objectives and Criteria; and Monitoring and Adaptive Management, yet recovery actions identified for each population were simplistic and redundant. In addition, the Recovery Plan fails to analyze which recovery action techniques have worked well in the ESU and which recovery actions have not had a measurable benefit.

Enhancement measures affecting large portions of the ESU will be the most effective and should have priority over locally important but site specific projects. We recommend a prioritization of restoration actions by geographic area using some sort of coho habitat and flow modeling approach to aid in prioritization. A "triage" approach may be required where watersheds that are too impaired or where populations are functionally extinct are overlooked for watersheds that could still be restored. We also recommend developing accurate critical habitat coverage for the ESU. This coverage could then be used to further downscale and prioritize restoration actions at the watershed and site level.

We would also like to see the prioritization process consider current and future climate change and its predicted impacts to streams within the ESU. Finally, we would like to see local biologists and stakeholders involved in the prioritization process.
ORAFS thanks you for the opportunity to comment on this important document that will help to recover a commercially, scientifically, and ecologically important Pacific salmon stock.

Literature Cited

Adams, P.B., L.B. Boydstun, S.P. Gallagher, M.K. Lacy, T. McDonald, and K.E. Shaffer. 2011. California coastal salmonid population monitoring: Strategy, design, and methods. Fish Bulletin 180. State of California, The Natural Resources Agency, California Department of Fish and Game. 80 p

Alsbury, T. 2012. Colonization of coho above natural barrier falls in Oregon: A History of supplementation and the expansion of coho range above Willamette falls. Abstract. Oregon Chapter American Fisheries Society Annual Meeting Eugene, Oregon.

Araki, H., Berejikian, B. A., Ford, M. J. and Blouin, M. S. 2008. Fitness of hatchery-reared salmonids in the wild. Evolutionary Applications, 1: 342–355. doi: 10.1111/j.1752-4571.2008.00026.x

Berejikian, B.A., and Ford, M.J. 2004. Review of the relative fitness of hatchery and natural salmon. U.S. Dept. Commer.,NOAA Tech Memo. No. NMFS-NFSC-61.

Berejikian, B.A., Mathews, S.B., and Quinn, T.P. 1996. The Effects of hatchery and wild ancestry on the development of agonistic behavior in steelhead trout fry (*Oncorhynchus mykiss*). Can. J. Fish. Aquat. Sci. 53: 2004–2014.

Burnett, K., G. Reeves, D. Miller, S. Clarke, K. Christiansen, and K. Vance-Borland. 2003. A first step toward broad-scale identification of freshwater protected areas for Pacific salmon and trout in Oregon, USA. Pages 144-154 in J. P. Beumer, A. Grant, and D. C. Smith, editors. Aquatic protected areas: What works best and how do we know? Proceedings of the World Congress on Aquatic Protected Areas, Cairns, Australia, August 2002.

Chilcote, M.W. 2003. Relationship between natural productivity and the frequency of wild fish in mixed spawning populations of wild and hatchery steelhead (*Oncorhynchus mykiss*). Can. J. Fish. Aquat. Sci. 60(9): 1057–1067. doi:10.1139/f03-092.

Chilcote, M.W., K.W. Goodson, and M.R. Falcy. 2010. Reduced recruitment performance in natural populations of anadromous salmonids associated with hatchery-reared fish. Can. J. Fish. Aquat. Sci. 68: 511-522.

FEMAT (Forest Ecosystem Management Assessment Team). 1993. Forest Ecosystem Management: an ecological, economic and social assessment. Report of the Forest Ecosystem Management Assessment Team. 1993-793-071. U.S. Govt. Printing Office.

Firman, J.C., E.A. Steel, D.W. Jensen, K.M. Burnett, K. Christiansen, B.E. Feist, D.P. Larsen, and K. Anlauf. 2011. Landscape models of adult coho density examined at four spatial extents. Transactions of the American Fisheries Society 140:440-455.

Ford, M.J. 2002. Applications of selective neutrality tests to molecular ecology. Molecular Ecology, 11:1245-1262.

Good, T.P., R.S. Waples, and P. Adams (editors). 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-66, 598 p.

Hard, J.J., B.A. Berejikian, E.P. Tezak, S.L. Schroder, C.M. Knudsen, and L.T. Parker. 2000. Evidence for morphometric differentiation of wild and captively reared adult coho: A geometric analysis. Environ. Biol. Fishes, 58: 61–73.

HSRG (Hatchery Scientific Review Group–Lars Mobrand (chair), John Barr, Lee Blankenship, Don Campton, Trevor Evelyn, Tom Flagg, Conrad Mahnken, Robert Piper, Paul Seidel, Lisa Seeb and Bill Smoker). 2004. Hatchery Reform: Principles and Recommendations of the HSRG. Long Live the Kings, 1305 Fourth Avenue, Suite 810, Seattle, WA 98101 (available from www.hatcheryreform.org).

ISAB (Independent Scientific Advisory Board). 2003. Review of salmon and steelhead supplementation. Report ISAB 2003-3,Northwest Power and Conservation Council. Portland, Ore.

Jonsson, B. 1997. A review of ecological and behavioral interactions between cultured and wild Atlantic salmon. ICES Journal of Marine Science, 54: 1031-1039.

Katz, J., P.B. Moyle, R.M. Quinones, J. Israel, S. Purdy. 2012. Impending extinction of salmon, steelhead, and trout (*Salmonidae*) in California. Environmental Biology of Fishes. http://www.springerlink.com/content/e732l750m54p5r65/abstract/

Kostow, K.E. 2004. Differences in juvenile phenotypes and survival between hatchery stocks and a natural population provide evidence for modified selection due to captive breeding. Canadian Journal of Fisheries and Aquatic Sciences 61:577–589.

McElhany, P., M. Ruckelshaus, M. Ford, T. Wainwright, and E. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-42, 158p.

Nehlsen, W., J. Williams, and J. Lichatowich. 1991. Pacific salmon at the crossroads: Stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16(2): 4–21.

Nickelson, T. 2003. The influence of hatchery coho (*Oncorhynchus kisutch*) on the productivity of wild coho populations in Oregon coastal basins. Can J Fish Aquat Sci 60:1050–1056.

NMFS (National Marine Fisheries Service). 1997a. Endangered Species Act - Section 7 Consultation Biological Opinion and Conference Opinion: Implementation of Land and Resource Management Plans (USFS) and Resource Management Plans (BLM); USDA Forest Service: Rogue River, Siskiyou, Siuslaw, Umpqua, and Winema National Forests; USDI Bureau of Land Management: Coos Bay, Eugene, Medford, Roseburg, and Salem Districts. NMFS, Northwest Region, Seattle, Washington. March 18, 1997

NMFS (National Marine Fisheries Service). 1997b. Endangered Species Act - Section 7 consultation, biological opinion and conference opinion on continued implementation of land and resource management plans (USFS) and land use planning documents (BLM): USDA Forest Service: Klamath, Mendocino, Shasta-Trinity, and Six Rivers National Forests; USDI Bureau of Land Management: Arcata, Clear Lake, and Redding Resource Areas. National Marine Fisheries Service (NMFS), Southwest Region, Long Beach, California. June 20.

NMFS (National Marine Fisheries Service). 2011. Southern Oregon/northern California coast recovery domain 5-year review: summary and evaluation of southern Oregon/northern California coast coho ESU. National Marine Fisheries Service Southwest region. Long Beach, California. 59 p

NWFP (Northwest Forest Plan). 1994. U.S. Department of Agriculture Forest Service and U.S. Department of Interior Bureau of Land Management. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl; standards and guidelines for management of habitat for late successional and old-growth forest related species within the range of the northern spotted owl. http://www.reo.gov/library/reports/newsandga.pdf

ODFW (Oregon Department of Fish and Wildlife). 2004. Upper Rogue smolt trapping project. restoration and enhancement project # 03-038. Central Point, OR.

ODFW (Oregon Department of Fish and Wildlife). 2005. Native fish status report. Salem, OR.

ODFW (Oregon Department of Fish and Wildlife). 2007. Oregon coast coho conservation plan for the state of Oregon. March 2007.

ODFW (Oregon Department of Fish and Wildlife). 2009. Cole Rivers Hatchery operation plan. 32 p.

Pollock, M.M., G.R. Pess, T.J. Beechie, and D.R. Montgomery. 2004. The importance of beaver ponds to coho production in the Stillaguamish River basin, Washington, USA. North American Journal of Fisheries Management 24:749–760.

Reeves G.H., F.H. Everest, and T.E. Nickelson. 1989. Identification of physical habitats limiting the production of coho in western Oregon and Washington. US Forest Service General Technical Report PNW 245.

Reisenbichler, R.R. and S.P. Rubin. 1999. Genetic changes from artificial propagation of Pacific salmon affect the productivity and viability of supplemented populations. ICES J. Mar. Sci. 56:459–466.

Riverbend Sciences. 2011. Beaver Mapper. Online map of beaver distribution in California and Oregon. Riverbend Sciences, Eureka, California. Available online at http://www.riverbendsci.com/projects/beavers Accessed 12/6/2011.

Stevens Jr, D.L. 2002. Sampling design and statistical analysis methods for the integrated biological and physical monitoring of Oregon streams. OPSW-ODFW-2002-07, Department of Statistics, Oregon State University, Corvallis.

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status review of coho from Washington, Oregon, and California. U.S. Department of Commerce. NOAA Technical Memorandum NMFS-NWFSC-24, Northwest Fisheries Science Center, Seattle, Washington. 258 p.

Williams, J.E., R.N., Williams, R.F. Thurow, L. Elwell, D.P. Philipp, F.A. Harris, J.L. Kershner, P.J. Martinez, D. Miller, G.H. Reeves, C.A. Frissell, and J.R. Sedell 2011b. native fish conservation areas: a vision for large-scale conservation of native fish communities. Fisheries. 36(6): 267-277.

Williams, T.H., B. Spence, W. Duffy, D. Hillemeier, G. Kautsky, T. Lisle, M. McCain, T. Nickelson, E. Mora, and T. Pearson. 2008. Framework for assessing viability of threatened coho in the Southern Oregon / Northern California Coasts Evolutionarily Significant Unit. NOAA Technical Memorandum NMFS-SWFSC-432. NMFS, Southwest Fisheries Science Center, Santa Cruz, CA. 97 p.

Williams, T.H., E.P. Bjorkstedt, W.G. Duffy, D. Hillemeier, G. Kautsky, T.E. Lisle, M. McCain, M. Rode, R.G. Szerlong, R.S. Schick, M.N. Goslin, and A. Agrawal. 2006. Historical population structure of coho in the Southern Oregon/Northern California Coasts evolutionarily significant unit. NOAA-TM-NMFS-SWFSC-390. NMFS, Southwest Fisheries Science Center, Santa Cruz, CA. 85 p.

Williams, T.H., S.T. Lindley, B.C. Spence, D.A. Boughton. 2011a. Draft status review update for salmon and steelhead under the Endangered Species Act: Southwest. NOAATM-NMFS-SWFSC-XXX. December 2010. National Marine Fisheries Service. Southwest Fisheries Science Center. Santa Cruz, CA.

AFS California-Nevada Chapter Review of the SONCC Coho Recovery Plan DRAFT Version: January, 2012

Main Comments:

General rules and concepts should be supported by scientific literature. Example: Page 31-4… "While much of the Rogue River from Grave Creek…. Too steep". According to what study(ies) has it been demonstrated that this section is too steep for spawning? What is the scientific literature that rules or governs where salmonids spawn? What evaluation showed that this section fell outside of this gradient? It is important to support these generalizations with scientific literature.

Population Structure and Historical Population Structure

The authors have not sufficiently demonstrated that their work adequately or realistically represents historic population structure or historic abundance and therefore the designations of core and non-core are hypothetical at best. The authors should admit the hypothetical nature of their population designations from the beginning and provide a design based monitoring and recovery plan to evaluate these theoretical population designations. The current effort, if sufficiently designed, is a great opportunity in this regard. We recommend they drop the core and non-core population designations from the draft plan, use a spatially balanced random sample design for estimating adult escapement following Adams et al. (2011), and evaluate their data at five year intervals to look for population structure within the SONCC ESU.

The entire plan is based on a set of hypothetical biological population designations that were arrived at based primarily on "professional judgment" and untested and uncalibrated models developed with limited or no data (the IP model and the CAPS workbook- see appendix b where the word professional judgment is used over 60 times in 30 pages). The core and non-core etc. population designations presented are subdivisions of subdivisions of the ESU derived by Williams et al (2006) which are based on uncertainty and the IP model. In the background section page, 1-4 (and elsewhere) the authors wrote that Oregon Department of Fish and Wildlife has concerns with the IP model and believe it vastly overestimates historic coho salmon abundance. We strongly agree with this statement. On page 2-1, lines 22-25, the authors admit this shortcoming of the model and then proceed to formulate the entirety of the plan on it anyway. There is little evidence to support the specifics of the IP-km modeling by Agrawal et al. (2005) and Williams et al. (2006). Thus, the values derived to determine population structure and numeric criteria for viability presented in this document within the SONCC ESU are based on limited data and subjective model interpretation. It would be prudent for the authors to admit this upfront and offer a scientific process to examine their hypothetical population structure in a formal design based monitoring and recovery program.

At best the IPkm attempted to model historic juvenile carrying capacity not abundance. The predications were of juvenile rearing habitat potential based on physical characteristics (slope, channel constraint, and discharge) of the landscape where IP becomes a proxy for habitat carrying capacity. The modeled IP has the likelihood that a stream will exhibit suitable habitat for juveniles, thus the criteria developed in the SONCC recovery document should be for juveniles, not adults. We suggests using "proxy for habitat carrying capacity" or "hypothetical modeled index of a proxy for historic habitat carrying capacity" rather than IP. Better yet, do not rely on these model outputs but rather use them to develop hypotheses about population structure within the ESU and test them.

The uncertainty in historic population structure pervades the development of the viability criteria. In Appendix C, lines 30-35 they admit that all populations are information limited (page 2-10, lines 28-30) and that their population designations could result from this lack of data rather than be due to true biological differences. The authors need to more clearly define and better defend their population structure and diversity strata. As it is Appendix C is not sufficient. Importantly it appears, based on the citation at the end of Appendix C, that Bradbury et al. (1995) (the primary document, which they modeled their population designation process on) is grey literature. I was unable to find this reference during review and thus have no way of ascertaining its appropriateness. The authors should know that McElhany et al. (2000), Crawford and Rumsey (2010), Willaims et al. (2006), Adams et al. (2011), and other documents important to pacific salmon recovery all focus on adult data for metrics of recovery. Therefore, the SONCC plan should primarily focus on adult metrics and not on juveniles as is currently the case.

Monitoring

Change the title of section 5 to “Design Based Monitoring: Testing population structure and recovery actions with science”

In the executive summary, lines 24-2, they state that monitoring is necessary to determine when recovery criteria have been met, however without a design based (i.e. statistically valid) monitoring plan it will be impossible to know. Currently, the SONCC recovery plan lacks a coherent design based monitoring plan. This is a major problem.

The monitoring section (section 5, pages 5-17 to 5-40) of the SONCC recovery plan is not design based, relies on untested population designations, lacks clear and measurable objectives, and deviates significantly from the California Coastal Salmonid Monitoring Plan (CMP) (Adams et al 2011). While the authors of this document appear to be aware of the current state and direction of monitoring in the region (references cited in lines 12-21, page 5-17), it seams they are attempting to strongly deviate from them. Crawford and Rumsey (2010), Adams et al. (2011), and Stevens (2002) all call for regional design based adult monitoring programs, driven by a spatially balanced random sampling design. The CMP specifically calls for regional adult monitoring based on redd counts calibrated and interpreted with data from life cycle monitoring stations (LCS). These regional data can be decomposed to evaluate hypothetical population structure within the ESU. In addition, Adams et al. (2011) recommended this monitoring because, given the design based approach, it is a cost effective compromise relative to stream specific censuses. The SONCC recovery plan should follow the CMP and have regional redd surveys calibrated with opportunistic LCS. If the plan only provided regional escapement estimates following Adams et al. (2011) it would be a significant improvement over current monitoring, leading to vastly improved recovery management prescriptions.

However, it appears the authors of the SONCC recovery plan have missed this very important point and instead they are proposing monitoring based on their hypothetical population designations (see main comment 1 above) with low intensity LCS monitoring. In their phase one monitoring they tell us monitoring will consist of life cycle monitoring with one LCS in each core population in each diversity strata without any other adult escapement monitoring. Recall, our main concern with this plan is that these populations are hypothetical at best, given the lack of data that went into their conceptualization they could be entirely wrong, potentially leading to disastrous mismanagement. While an intent of LCS in Adams et al. (2011) is to provide freshwater and marine survival (as the authors of the SONCC recovery plan propose), this must be in context. This survival information is primarily collected to help interpret potential trends in escapement from regional adult monitoring to help determine if ocean conditions or the myriad of actions intended to improve freshwater conditions are working to improve adult escapement (Adams et al. 2010). LCS were never intended to replace regional escapement monitoring, only to augment it.

The SONCC plan should adopt the strategy (Adams et al. 2011) currently being developed in coastal California (i.e. regional redd surveys calibrated with LCS data) and use it to evaluate their hypothetical population structure and examine the regional impact of recovery actions. Having monitoring vary by population type (we believe these designations are hypothetical at best) is an inappropriate course given the current direction of monitoring in California, especially since the population designations in the draft recovery plan are suspect. Dividing efforts between LCS and juvenile surveys and requiring LCS's in every core population will result in costly over sampling. The authors acknowledge that LCS will have to be located in smaller streams and that they will have to be opportunistically rather than randomly located. Given that there are only a few of these potential sites in the SONCC, the cost associated with operating an LCS, and the idea that these sites may or may not show variability in freshwater and marine survival it is not prudent to recommend these as your primary tool for evaluating recovery. We recommend regional adult surveys conducted in a spatially balanced random design, calibrated and interpreted with data from LCS, consistent with CCC recovery monitoring and the current direction of monitoring in California (Adams et al. 2011

Habitat surveys- There is a general discussion of comprehensive habitat surveys throughout the document, especially with the reference to Table 5-6. However, I could not find any clear description of what these surveys should entail. It is imperative that habitat surveys be standardized to provide clear comparisons of what is lacking or sufficient throughout the ESU. Habitat delineation should be clearly associated with key lifestages within the life history of coho salmon, both describing the quantity and quality of these habitats. The document should provide a better definition and description of habitat assessments. What are "applicable habitat indicators"? Perhaps a conceptual model of coho life histories and potential stressors within each might be helpful?

Sediment - There is an over-generalization of sediment issues in document. Example on page 1018 "reduce delivery of sediment to streams." This is further emphasized in the Klamath River section, page 18-31: "Reduce delivery of sediment to streams." Sediment is naturally occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of fluids such as wind, water, or ice, and/or by the force of gravity acting on the particle itself. These particles can be of a size from fine silt to boulders larger than an automobile. Each size class provides important ecological function to salmonid streams. I would assume the authors intend to emphasize the reduction of "fine sediment" such as sand and silt. However, to what level of "reduction"? At high concentrations, fine sediment can reduce primary productivity, macroinvertebrate production and impact growth, development and survival of salmonids at several life stages. However, fines also provide a matrix for riparian plants to germinate and grow in and can offer insulation to developing salmonid embryos from high flows at relatively low levels.

Lack of coarse sediment input can also exacerbate channel incision caused by flow regulation, disconnecting floodplains and channels. This disconnect is a recurring theme throughout the document so quantifying a coarse sediment supply seems justified in most of the impacted systems. The concept is to identify healthy sediment budgets for salmonid streams and support the proper management of these systems to allow ecological function and support the quantity and quality of habitat requirement needed to meet restoration goals.

I would recommend a more clear description and classification of "sediment" as it relates to coho life history and devise a conceptual idea as to how it should be monitored and managed to optimize healthy coho populations.

Large Woody Debris **-** Similarly, woody material is referenced throughout the document. The terms woody material, large woody debris (LWD), large wood etc. are used interchangeably. I recommend that a single term is chosen when discussing production of woody material that is meant to provide forcing agents and other aspects of channel forming processes. If initials (e.g. LWD) are to be used, they should be provided near the beginning of the document and then used throughout the rest of the document. Continuing on this subject, good citations are provided on the topic of woody material as forcing agents (Montgomery, Buffington etc). However, there is no recommendation of estimating how much material is needed to support healthy coho streams. There are some citations of the TNC to describe large wood but these are not published documents.

Forced pool habitat associated with woody material is considered one of the highest-used spawning habitats for coho salmon (Buffington et al. 2004). Researchers sometimes quantify the amount of LWM in streams by using the number of pieces per 100 m that are large enough to influence the channel characteristics (Stillwater Sciences 1997). House and Boehne (1986) estimated that, in a relatively undisturbed section of a small stream in Oregon, there were 18 pieces of LWM per 100 m large enough to influence the channel. Sedell et al. (1982; 1984) found that five (1982 study) and four (1984 study) pieces of LWM per 100 m influenced the stream channel by creating pool habitat in undisturbed channels of the South Fork Hoh River, Washington. Bilby and Ward (1989) surveyed characteristics of LWM in western Washington streams and found that size of stable pieces of LWM increases with stream size. Their values suggest that streams under 5 m in width require trees of about 30–35 cm in diameter to be useful as fish habitat and to be able to persist as stable LWM in the channel. Streams of about 10 m in width require larger trees of about 45 cm (1.5 ft) in diameter. In a basin in which over 50% of the forest had been logged in the past 20 years, House and Boehne (1986) found that the reduction of large conifers in the riparian zone resulted in only 0.4 pieces per 100 m of LWM large enough to influence channel morphology. Rosenfeld and Huato (2003) found that the proportion of wood material that formed pools increased from 6% for pieces with a diameter of 15–30 cm to 43% for pieces with a diameter of more than 60 cm. Large woody material more than 60 cm in diameter formed a higher proportion of pools across all channel widths. A simple, size-structured model of LWM abundance in small streams suggests that loss of LWM larger than 60 cm in diameter will greatly decrease pool frequency across all channel widths but have the greatest impact on large streams.

I recommend that the document promote the development of methods for estimating annual quantities of large woody material and the processes needed to maintain wood supply equilibrium within these target coho streams.

Mining and Gravel Extraction
The mining issue is quite complicated and should be put into a better context of how it complicates other coho salmon stressors. For instance, extensive mining activities for sand, gravel, construction aggregate and gold in a stream's floodplain and channel can created major habitat impacts already exacerbated by flow regulation. Reduction in flows and associated reduction in sediment transport into a regulated, mined system can modify a stream's geomorphological and hydrological processes. These modifications can result in very limited gravel recruitment and sediment transport. Without hydrologic and geomorphological processes, remaining salmonid spawning gravel is immobile and susceptible to compaction and/or armoring. When armoring occurs, the potential salmonid habitat becomes unavailable for salmonid production. Furthermore, mining tailings often leave much of the floodplain perched. This impact, coupled with channel incision due to the sediment and hydrograph budget modification, can further exacerbate this effect, reducing the availability of valuable rearing habitat. Armored banks from remaining dredger tailings do not allow laternal channel migration, therefore, channel scour is accelerated, further decoupling the river from its floodplain with remaining spawning gravels eroded away.

Impaired Estuary/Mainstem Function and Floodplain
There has been some excellent work done by Bottom, Gray, Simestad etc. specifically associated with coho and estuaries and floodplain and secondary habitats. These should be cited and discussed in these sections.

Gray, A., Simenstad, C.A., Bottom, D.L., Cornwell, T.J., 2002. Contrasting functional performance of juvenile salmon in recovering wetlands of the Salmon River estuary, Oregon, USA. Restor. Ecol. 10, 514–526.

BOTTOM, D. L., C. A. SIMENSTAD, A. M. BAPTISTA, D. A. JAY, J. BURKE, K. K. JONES, E. CASILLAS, AND M. H. SCIEWE. 2001. Salmon at River's End: The Role of the Estuary in the Decline and Recovery of Columbia River Salmon. U.S. National Marine Fisheries Service, Seattle, Washington.

Reviewed Systems
Rogue River
Applegate sub-basin
Document specifically indicates Applegate Dam blocks coarse and fine sediment supply to the lower mainstem Applegate River. Yet, there is no discussion of coarse sediment injection or the concept of a sediment budget for the system. USFWS has done extensive surveys of Applegate river demonstrating need of gravel injection. Lack of coarse sediment within regulated systems typically exacerbates disconnection of main channel from floodplain and secondary channels. These are indicated as "High priority" issues in document. Gravel augmentation could have other ecological and geomorphic benefits including increased sinuosity and bar formation, and decreased summer water temperatures; a high restoration priority in the Applegate subbasin.

Mining accumulated reservoir sediment deposits could provide gravel for augmentation, increasing reservoir storage and summer base flows.

Klamath Basin

When the recovery plan speaks of the Klamath Basin and also excludes Tribal lands from the recovery plan, a significant portion of the lower and middle Klamath Mainstem is excluded. Given the number of tributaries that can function as either summer or winter base habitat for coho this is problematic. In addition tributaries and off channel habitat in the Klamath estuary is contained within the territorial boundaries of the Tribes in the area. Tribal lands that were excluded in the critical habitat designation on the Klamath Basin include: Hoopa Valley Indian Reservation, Karuk Reservation, Quartz Valley Reservation, Resighini Rancheria, and Yurok Reservation. To exclude the Yurok Reservation and the streams in the lower and upper estuary is to exclude known hotspots for young coho in the Klamath Basin. Non natal rearing occurs there and the Karuk and Yurok's have done some interesting work on documenting coho movements. In addition the Yurok's have put a lot of effort into restoring the mouths of many of these tributaries.

The recovery plan covers the major activities responsible for the decline of coho salmon across the Klamath Basin tributaries. Major activities were identified as follows: logging, road building, mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals, and unscreened diversions for irrigation (62 FR 24588, May 6, 1997). Trinity, Siskiyou, parts of Humboldt Counties that encompass the majority of the Mainstem Klamath below Iron Gate Dam and its tributaries are sparsely populated areas. However the area is still managed heavily for forestry, mining, water and other extractions of resources. The legacy of gravel and gold mining, poor management of steep slopes and highly erodible soils, fires, logging and county roads, undersized culverts, water withdrawals from small perennial streams for irrigation or new homes still contribute to the decline of small tributary habitat.

Trinity River, South Fork Trinity, Mainstem Klamath Rivers all listed as having high Total Maximum Daily Loads (TMDLs). Significant effects of farming in areas outside of the Scott and Shasta rivers were not considered in the Recovery Plan. Significant efforts at restoration have been made to reduce TMDL on the Trinity River, South Fork Trinity and lower Klamath River tributaries. However, significant sources of new sediment from landslides, illegal farming, as well as pulses of old sediment moving downriver continue to contribute sedimentation in the Klamath Basin. In both the Klamath and Trinity watersheds unregulated agricultural activities in steep watersheds dewaters streams, clears vegetation, increases erosion, and irrigation may increase the liquidity of the farmed soils. These unregulated activities increase the risks to smaller tributaries and have the potential to increase sediment in rivers which already suffer from high TMBL. Landslides continue to occur in the basin due to steep slopes and liquefaction during torrential downpours.

Overall concern I have for the middle and upper Klamath River is that many of the strategies for improving hydrology rely on improving regulatory mechanisms. This is highly contentious in the Klamath Basin.

Dams and water diversions are responsible for significant loss of habitat. However, mainstem refugia for non-natal summer rearing are available due to cold water from Trinity and Lewiston Dams cool the upper Trinity far beyond historical levels during the summer months. While the

Plan states that conditions in summer downstream of Douglas City are higher than the published range (39-14) these temperatures are higher than historical temperatures would have been in this area.
The Plan talks about the estuary as being crucial for Trinity Basin coho salmon. I would argue that if this is the case that the critical habitat should include the Yurok and Resighini tribal territorial lands.

Three artificial propagation programs were added to the SONCC coho salmon ESU: The Cole Rivers Hatchery, Trinity River Hatchery, and Iron Gate Hatchery coho hatchery programs. TR and IG Hatcheries are highly successful at producing coho yearlings and recent improvements have increased survival to about 3%. The success of the hatcheries has led to high levels of straying of hatchery fish into natural areas. While the Recovery Plan identifies the issues it does not provide a strong basis for encouraging hatchery management agencies to reduce production or change the hatcheries into conservation hatcheries for coho salmon in order to minimize the detrimental effects hatcheries have on natural production.

" Large subbasins in the Trinity, Eel, Rogue, and Klamath River that have over 200 IP-km are designated as Functionally Independent while basins that have less than 200 IP-km are designated as Potentially Independent." I would argue that with 60% or more of natural area spawners of hatchery origin that the population in the Trinity River is being driven by the hatchery and may not be able to sustain a natural population independent from the hatchery. This interplay of high levels of hatchery strays does not emerge as a strong issue with a strong recommendation. Until the hatchery influence is reduced, habitat is restored, and harvest is managed, the natural populations in the Klamath Basin cannot recover.

To establish targets for natural area spawners is problematic without presenting evidence from the literature or similar sized recovered river systems as a template for this decision. The Plan cites 5,000 wild adult coho salmon passing Lewiston but has little data on tributaries below the town of Lewiston in the pre-dam era. The amount of potential habitat that is left should enter in this calculation. Was this calculated for the post dams river?
In Trinity County recent public antagonism has increased towards restoration actions to increase large woody debris in the river, replace gravel lost behind the dams, and to lower floodplains to reactivate the floodplains to improve streamside tree retention and floodplain refugia from high flows. Another item not addressed is the increased human populations and public education that may be required to encourage preservation of riparian areas on private lands, conservation of water, as well as to increase support of restoration.
What evidence does NOAA have that a variable flow in the Trinity to replace the static flow from October to April will improve coho salmon habitat? This does not appear to be based on analyses of flow and stage relative to features along the Trinity.
Restoration strategy calls for construction of off –channel ponds, alcoves, backwater habitat and old stream oxbows. Again public education and assistance with the public is a crucial part of the restoration strategy that must occur. Restoration strategy calls for increase in LWD again public education will be crucial because of backlash against the program for putting these features into the river.
NOAA needs to be firmer about what is required in terms of hatchery revision in the California Hatchery Review, and promote the development of the Hatchery and Genetic Management Plans for IGH and TRH.

Mid-Klamath River Population **(**Chapter 33)

Page 10 Suitable temperatures for juvenile rearing stated as <19C; 19C is high according to Richter and Kolmes 2005 and others; suitable temperatures should be below <16C, suggesting that habitats in tributaries are marginal rather than suitable (could have an impact on habitat improvement targets)

Page14 High intensity fires seems at most a moderate threat to adults since fires are generally out by the time spawning migrations begin; erosion resulting from catastrophic fires is more likely to impact embryos, fry and juveniles
Page 14 Climate change on the other hand is likely to have at least a moderate impact on eggs and fry as a result of higher flows associated with bigger, more frequent winter storms

Page 14 Peter and Ron's article suggests that 90% (need to verify) are of hatchery origin; therefore, hatchery effects should be rated as "high"

Page 17 table; there is no Ukonom district anymore; district name is now Salmon-Scott River Ranger District or Orleans District depending on location of barrier.

General comment: For many years, the tribal fisheries has been assumed to have little impact on the recovery of coho. While this may be true, no concrete, systematic estimates of tribal harvest exist. With numbers suppressed and declining, I wonder if any take is curtailing escapement of adult spawners.

Salmon River Population (Chapter 35)
Page 4 second to last paragraph: with coho returns significantly increasing over time, it is difficult for me to believe that coho in the Salmon River do not include hatchery strays. My hunch is that hatchery influence is underestimated.

Page 11 In the late 1980s - early 1990s, there was an intensive brood box breeding program (not sure if for coho, e.g. in Olso and Nordheimer Creeks), I don't have the data at hand but I wonder if there are any legacy effects. D. Hillermeier (Yurok Tribe) once told me that the program resulted in a drastic change in sex ratios (all males?). Someone would need to track this information down.

Page 17 Summer dams can be a problem if fish have not outmigrated before the recreational season begin. The FS and SRRC have been monitoring summer dams during snorkel surveys.

Page 22 Increase instream flows as a goal? How? The Salmon is not regulated, there is little diversion, and building of headwater reservoirs could result in other adverse impacts.

Scott River
Within the Scott River, large-scale alteration of channel form and function has caused large volumes of coarse sediment to overwhelm transitional reaches of Scott River tributaries and the river itself. This exacerbates the over-drafting of water from the system and causes extensive reaches of the system to go subterranean during portions of the year, disconnecting stream sections and inhibiting certain lifestages to access important habitat during critical periods. This should be more clearly addressed.

Also, a large-scale assessment of spawning habitat in the Scott River was developed through a cooperative effort from the Siskiyou Resource Conservation District, California Department of Fish and Game, the Pacific States Marine Fisheries Commission, and private consultants (Scott River Spawning Gravel Evaluation and Enhancement Plan 2010). The document provides a description of the scientific approach used to identify salmonid spawning habitat conditions and prioritize potential enhancement locations and the results of the application of this approach on the Scott River Watershed. The broad-level study approach was designed to assess watershed processes and determine potential impacts to salmonid spawning and incubation habitat, emphasizing coho salmon. The Plan provides watershed stakeholders with a framework for identifying, quantifying and qualifying spawning habitat for anadromous salmonids within the Scott River Basin and for prioritizing and strategizing the protection and maintenance of quality habitat as well as enhancement of sub-optimal habitat. The document also provides a watershed-wide survey of woody debris. This should be, at a minimum, cited in the document.

Page 1 In the lower half of the river (canyon reach and tributaries), a principal threat is timber harvest, particularly in privately owned lands.

Page 12 Water master-ring has not been effective at maintaining 30 cfs minimum flows. USGS gage data can confirm this.

Specific Issues

Reviewer 1

Page xviii- Figure has no title and no explanation. Legend should be linked to information on page 5 that describes what Core, non-core 1 etc means.

Page xix- it is unclear what is meant by: "At the ESU level, SONCC coho salmon must demonstrate representation, redundancy, connectivity, and resiliency." The average reader will require a better explanation as to what is meant by that very important statement.

Page xix Table has no title. What does "low", "moderate" etc mean? Where can a reader find the definitions?

Pages xx – xxi figures with no titles. Provide clear figure titles that explain to reader what the information is to convey. There is also language at the top of page xx that is somewhat "jargony" ; typical language that frustrates the public. Concepts such as "broad-sense restoration" should be more clearly defined.

Page xxii line 20 – sentence "and other collection" does not make sense
Line 30 – "add or discontinuing actions or strategies" based on what?
Line 39- "below low-risk of extinction adult spawner abundance targets" is confusing
Page xxiii line 30 – remove "ultimately"
Page 1-5 – "altered biological communities" does not fit under category of "declines in water quality"

Page 1 change "on 1999" to "in 1999"

Page 2 – under viable, “storms” are listed as a periodic catastrophic event. Why? For flooding? Because this is already listed. What about fire?

Page 10 – remove “of” from “This section provides of a brief”

Page 11- first paragraph references photo of beaver activity to the right. The photo is actually on the next page.

Page 12 – green information box, I would recommend referncing the fact that temperature has a significant effect on water’s ability to carry oxygen. Cool water means higher DO capabilities.

Page 13 – “Decrease mortality associated with barriers by screening diversions” this does not make sense. Do the authors mean “associated with entrainment”?

Page 14 – “Reduce predation and competition by reducing the abundance of predatory or competing species…” This is far to simplified and may actually create problems. I assume the authors are suggesting the removal of invasive species. However, with the present language, this suggests the removal or any species perceived to be a threat, including herons, kingfishers, and other native species. Please clarify these concepts.

Page 14 – Some of these concepts, as mentioned above, are over-simplified and may actually confuse the reader. Where can one find information on where and how to “reduce hatchery effects”? These bullets need more than one or two sentences.

Page 16 – add “to” to “…monitoring in order track stresses” and in “…recommend monitoring in order track threats”
Page 16- wouldn’t the term “stressors” be more appropriate than “stresses”?
Page 16- “conduct a comprehensive survey of habitat”. This is far too general and it is unclear how this will identify stressors. Clarify and be more specific for the reader to understand what is meant by the concept.
Why the two bullets at the end of the “Threats” section. “limiting factors” is in first but not in second. There are also no clear explanations as to why these actions are suggested. Considering “affected landowners” are considered “conservation partners”, these concepts need to provide readers with a better understanding of why they are chosen or at least where the reader can find further information.

Page 17 – Blue figure has “sockeye” instead of coho.

Improve quality of figure 3-4 on page 3-40

Figure 2-8: no Chinook line is provided.

IP Model is used freely throughout the document. First, shows up on page 63 and it took quite some time to figure out what was meant by it. This is the first location that it should be fully spelled out. Considering the authors wish the recovery plan to be used voluntarily by stakeholders and laypeople, I would recommend that at a minimum, a condensed explanation of the ideas put forth in the IP Model are provided in this document to help the reader understand.

A good example comes from suggestions made by the Oregon Chapter of AFS in 2001: http://www.orafs.org/pdfdocs/UWRCFMEP.pdf

What is "floating weekly maximum temperature"? Both this and MWMT are used in Fig 31-

Reviewer2

Executive summary, line 19: Voluntary? Is that all?

Line 34-40: Populations should be evaluated for at least four generations or 30 years. Salmon populations fluctuate on muti-decalale time-scales.

Throughout: core and non core are presented but not substantiated or defended.

Page 17: Adaptive management is Science, just say scientific method used in management.

Figure 1-1, where did the needed number come from? Please defend this number and provide context.

Page 1-4, lines 1-10: We also have serious concerns with this model and it's application here.

Page 2-1. lines 10-17: We also have serious concerns with this model and it's application here.

Page 2-1, lines 25-30: hypothetical modeled index of a proxy for historic habitat carrying capacity

Page 2-5, lines 1-6: We also have serious concerns with this model and it's application here.

Page 2-5, lines 17-20: You need to seriously describe and defend these. They come unexpectedly here and do not make sense in context. See major comment 1 above.

Page 2-10, lines 28-33: Yes there is little data, yet somehow you were able to apply this in your models in appendix c and elsewhere? This is very suspect.

Page 2-14, lines 15-16 and throughout document: The authors are using and throwing around depensation and that stream populations are below it. However, I can not find any place in the document where these values are discussed, presented or defended. How do you know what this value is and can you defend it?

Page 3-5, lines 111-13: What is a CAP workbook? This jus comes unexpectedly here.

Page 3-9, lines 20-21: So what?

Page 3-25, lines 18-22: Removal of large wood in previous decades was thought, as were hatcheries, at the time to be the proper prescription to help the fish. Calling this misguided misses the context of the time. Imagine in the future how scientists might characterize this document and your efforts. Especially given the level of “professional judgment” it took to create this document.

Page 3-25, lines 18-22: We suggest you treat the idea that wood may be in lower abundance than in the past as a hypothesis and add testing this to your overall design based monitoring.

Tables 4-1 and 4-2: These population types are hypothetical and we suggest you treat them as such. Might be best to abandon them all together.

Page 5-17, lines 4-6: Adaptive management is using science to guide management, see it, say it, live it.

Pages 5-17-5-41: see major comment 2 above.

Page 5-22, lies 5-8: Please substantiate this claim?

Page 5-27, section 5.2.1: This should all be design based monitoring, as it is written it will only amount to a lot off money being spent with little learned and perhaps no gain for the species. Especially since, you have no idea where these populations are or if they even exist (lines 1-3 page 5-28). Please see major comment 2 above.

Table 5-6: Censusing habitat in all these streams will be costly, we recommend that this sampling be design based and have statistically valid repeatable methods.

Table 5-7: Where is the sampling design, what are the questions? You need design based sampling plan to apply adaptive management to this monitoring. As it is presented here it, looks destine to fail.

Section 5.2.2: Do you recommend using these models or is this just a nice literature review? What is the point of this section? Please clarify or remove it.

Section 5.2.4: To critically test hypotheses associated with recovery and management you need a study design, we recommend the entire plan be redone and include design based monitoring. Please see Adams et al. (2011) as an example. Your main hypothesis should include testing your proposed population types.

Table 5-2. To critically test hypotheses associated with recovery and management you need a study design, we recommend the entire plan be redone and include design based monitoring. Please see Adams et al. (2011) as an example. Your main hypothesis should include testing your proposed population types.

Page 6-1, lines 20-25: This is a bad idea, monitoring should focus on the entirety of species space. Please see https://salmonmonitoringadvisor.org/. Focusing on the good areas only has caused both Washington and Oregon to make large errors in management.

Appendix A: Who did this and why? Please provide details and references. As such it is not defensible.

Appendix B: This section is entirely dependent on "judgment" and lacks data and information necessary for critical review. The Cap workbook should be day lighted and be subject to critical peer review. Professional judgment is used 64 times in 30 pages.

B.6: Cap work book, lines 20-21: these population designations are hypothetical at best, applying professional judgment to hypothetical designations… Garbage in garbage out.

Page b-11, lines 5-10: Rewrite to say, "We did not like the model results as they did not jibe with our perception of the world, so we changed the results to fit our fancy."

Page b-12, climate change: good.

Appendix C:

Bradbury et al. (1995) appears to be grey literature.

Page c-1, lines 0-5, intro: Professional judgment is used to rate these? We recommend you drop these population designations and design your monitoring plan to test for their existence in an experimental setting. Please see major comment 1 above.

Western Division of the American Fisheries Society

A Scientific Review of the 2012 Draft Recovery Plan for the Southern Oregon Northern California Coast Evolutionary Significant Unit of Coho Salmon (*Oncorhynchus kisutch*)

EXECUTIVE SUMMARY

The plan exceeds our expectations with respect to population analysis and recovery requirements, but fails in the habitat and monitoring components. We recommend a major revision of the Recovery Plan because of the mismatch between sophisticated "state of the art" biology (Chapters dealing with Structure, Viability and Status of the SONCC Coho Salmon; Conservation and Recovery Goals, Objectives and Criteria) and the simplistic redundancy of recovery actions identified for each population. The Recovery Plan's major failure is that the recovery actions simply prescribe the same piecemeal approach to coho salmon recovery from the past without a coherent restoration strategy based on the best available science pertinent to coho salmon. The billions identified for recovery actions could easily be wasted because habitat restoration/protection lacks a structured priority for implementation, lacks a hierarchical spatial approach based on the spatial partitioning of habitat by coho salmon, and lacks sufficiently rigorous adaptive management and monitoring plans. What needs to be done first? Where? Why? How? Scattering expensive projects over the vast ESU with no apparent science based strategy is not going to yield results. Models, case studies, and expertise exist to upgrade the habitat portions of the Recovery Plan to pinpoint where and what kinds of management would be effective and to establish ordered priorities for effective use of funds. We urge you to convene land managers, experts in habitat protection/restoration, and practitioners/technicians to develop a short term emergency recovery plan for decisive actions designed to reverse some of the alarming population trends identified. NMFS needs to identify a statistically valid monitoring program and fund states agencies as contractors; failure to fund a rigorous adult and juvenile monitoring program suggests that the ESU needs to be listed as endangered, simply out of ignorance of its true status and trends. Thus, we recommend that the SONCC coho salmon ESU be listed as endangered until population monitoring, recovery planning, and implementation indicate otherwise.

INTRODUCTION

The Southern Oregon Northern California Coast (SONCC) Evolutionary Significant Unit (ESU) of coho salmon (*Oncorhynchus kisutch*) occupies a vast mountainous area straddling the Oregon/California border (p. xviii). The ESU encompasses the Franciscan and Klamath-Siskiyou physiographic provinces that contain three major river basins: Rogue River, Klamath River, and Eel River (FEMAT 1993: V-I-2,3). Fisheries managers, fishers, and fisheries researchers in this area became aware of local declines of naturally produced coho salmon during the 1970s and1980s. The geographical extent and severity of the declines were not generally known or scientifically accepted until "Salmon at the Crossroads" was published in 1991 and widely distributed (Nehlsen et al. 1991). In 1993 President Clinton convened a large team of scientists and managing agencies to develop a federal forest plan to improve forest management for spotted owls and imperiled salmon. Fisheries scientists rose to the occasion and developed the Aquatic Conservation Strategy based on the newly emerging watershed analysis approach for fish habitat protection and restoration. Nevertheless, the severe declines of coho salmon and lack of effective habitat conservation on private lands led to the federal listing of SONCC coho as threatened in 1997 and the listing was reaffirmed in 2005. Fisheries scientists and land managers have had more than 20 years to halt the decline of coho salmon and restore habitat. Recent analysis of coho salmon population data and habitat data from several published sources now strongly indicate that the issue at hand is not one of fine tuning a Recovery Plan but of averting a well-documented decline to extinction.

RECOMMENDATIONS

We take the approach that recommendations affecting large portions of the ESU will be the most effective and would have priority over locally important but site specific projects.

Endangered Species Act status of the SONCC coho salmon ESU

The Recovery Plan (2-15) states that "[b]ecause the extinction risk of an ESU depends upon the extinction risk of its constituent independent populations (Williams et al. 2008) and the population abundance of most independent populations are below their depensation threshold, *the SONCC coho salmon ESU is at high risk of extinction and is not viable*." (emphasis added) This startling revelation is supported with sophisticated population viability analysis (Chapter 2), a summary of recent coho declines and local extirpations reported in a NMFS status review (p.1-10; NMFS 2011), data from Williams et al. (2011a), and an independent analysis of salmon species status throughout California that ranked the SONCC ESU as endangered (Katz et al. 2012:Table 1). Oregon Department of Fish and Wildlife disputes the Recovery Plan's high extinction risk rating for Illinois River and Middle Rogue/Applegate independent coho populations (2-17)—but lacks the data to justify its position in a rigorous manner. Regardless of the actual extinction risk of interior Rogue Basin coho populations, the dismal situation for the ESU as a whole is not likely to change soon because there is little systematic annual monitoring of wild coho populations in the ESU that could refute the high extinction risk ratings listed in Chapter 2, declines documented by NMFS (2011), Williams et. al (2011a), and endangered ranking by Katz et al. (2012). Therefore, we recommend that the SONCC coho salmon ESU be listed as endangered until rigorous population monitoring and recovery planning and implementation indicate otherwise.

Hatcheries and Harvest

Cessation of hatchery coho production in the Oregon Coastal coho ESU and virtual elimination of directed take on naturally produced coho is the most effective combination of management actions that has synergistically resulted in measurable trends towards coho salmon recovery goals. We recommend elimination of hatchery production/harvest in the SONCC coho ESU until recovery is documented. The plan (p.3-9) states that "The information available indicates that the influence of the hatchery stocking program on the genetic fitness of wild coho populations in the Klamath and Trinity rivers is significant. Moreover, because the Klamath and Trinity watersheds represent a large proportion of spawning and rearing habitat in this ESU, it is concluded that hatchery impacts are significant at the ESU level." Therefore, we recommend that hatchery coho salmon production be terminated at Cole Rivers Hatchery (Rogue Basin), Trinity River Hatchery (p. 1-9), and Iron Gate Hatchery (both Klamath Basin). Iron Gate Hatchery also contributes to disease outbreaks (p. 3-20,21). The scientific rational for ceasing hatchery coho production is compelling (Chilcote et al. 2010; Nickelson 2003). Similar concerns exist for other salmon species (Ruggerone et al. 2010; 2012; IMST 2007b; 2011; Johnson et al. 2012; Holt et al. In Press). ODFW ceased coho production at the Alsea Hatchery to aid Oregon coastal coho recovery. Hatchery production of coho salmon was discontinued in the Willamette

River in 1997 due to concerns of adverse interactions with listed salmon and steelhead. Unexpectedly, the former hatchery coho population became self-sustaining and now numbers over 20,000 adults (Alsbury 2012). Since hatchery fish at each of the three SONCC hatcheries are genetically similar to naturally produced coho, cessation of artificial production could allow returning adult coho to become naturalized with potential benefits to ESU viability (p.1-9). Eliminating hatchery fish would also simplify monitoring escapement in the ESU since all spawning coho salmon would likely be naturally produced.

Monitoring

The Recovery Plan fails to make an analysis of which techniques (recovery actions) have worked well in the ESU and which recovery actions have not had a measurable benefit. A long term data set of coho adult spawning from numerous small streams would provide some scientifically valid feedback for adaptive management (p. 5-19). Long term data sets for Oregon Coastal coho have demonstrated that low road density at the 7th field watershed scale are correlated with higher numbers of coho spawners and "weak rock" geology is correlated with lower coho spawners (Firman et al. 2011).

Relying on state budgets for adult monitoring is not working. ODFW has discontinued systematic coho spawning counts in the ESU and seemingly has no plans to resume them. Monitoring in California is inadequate. Perhaps the transboundary nature of the ESU has something to do with the reluctance to monitor. We recommend that the NMFS contract standardized coho monitoring for the entire ESU based on Adams et al. (2011) and Stevens (2002) so that comparisons and analysis of all coho populations are scientifically valid, regardless of state of origin. We recommend that coho monitoring be mandated with adequate funding independent of the Recovery Plan.

More rigorous ecological, social, and economic monitoring at local and catchment scales is needed to accurately evaluate coho status and trends, environmental conditions, and mitigation efforts (IMST 2006; 2007a; 2011b). Although various governmental agencies monitor the ecosystem effects of land use to varying degrees, those programs lack common or standard survey designs and indicators, sampling protocols, database management, or reporting units. The lack of interagency coordination and standard methods hinders determining the effectiveness of rehabilitation efforts to conserve aquatic ecosystems (Bonar and Hubert 2002; IMST 2007; 2009; 2011b; Roni et al. 2008; Hughes and Peck 2008; Stewart et al. 2009). Mulvey et al. (2009) reports an exception to that pattern. Twelve different federal, state, university, and local institutions benefited from standard designs, indicators, sampling protocols, and data sharing that encompassed a total of 450 river and stream sites in the Willamette Basin, Oregon.

To date, effectiveness monitoring has been inadequate to assess whether ecological objectives of rehabilitation projects have been met (e.g., Roni et al. 2002; Bernhardt et al. 2005). Bernhardt et al. (2005) and Katz et al. (2007) reported that only 370 of 37,000 USA projects and 154 of 23,000 Pacific Northwest projects reported any type of monitoring. Major discrepancies have been reported between managers' evaluations of success and the quality of monitoring data needed to verify that success (Alexander and Allan 2006; Follstad-Shah et al. 2007; Hassett et al. 2007; Katz et al. 2007; Sudduth et al. 2007). Shields et al. (2003) reported that determining the effectiveness of stream rehabilitation projects is hindered by the need for long term studies and the linear nature and spatial and temporal variability of streams, which create pseudoreplication issues. Thompson (2006) concluded that only 12 of 79 studies of fish habitat rehabilitation projects included enough data to assess their effectiveness on trout populations, and only 2 of the 12 actually increased trout populations.

Effectiveness monitoring plans should be developed and funded at the same time as development of rehabilitation plans and the monitoring should be conducted at the catchment and reach or segment scale versus the site scale. The monitoring should be directed by quantifiable objectives, conducted over multiple years before and after the proposed development or project, and assessed via standard, quantifiable indicators (IMST 2006; Hughes and Peck 2008; Paulsen et al. 2008). Possible objectives include decreased bed and bank erosion, increased fish passage and instream cover, decreased nutrient and toxic loads and concentrations, greater numbers of desired species and fewer numbers of undesirable species, higher multimetric index scores for vertebrates and macroinvertebrates, greater cover and complexity by native riparian vegetation, and increased public acceptance of projects and regulation (e.g., Woolsey et al. 2007; Paulsen et al. 2008).

List ODFW Minimum Flows for Oregon SONCC Streams
Oregon Department of Fish and Wildlife has applied for instream water for fish in numerous SONCC streams. The ODFW water rights are often "junior" water rights. The streams are often depleted of water by senior water rights holders. Tens of thousands of federally listed coho salmon die each year in the Rogue Basin due to water withdrawals and lack of screening. We recommend that the Recovery Plan acknowledge that the ODFW flows for individual streams are the best available scientific information and list the flows for each stream in the Recovery Plan. We recommend that in agricultural areas such as the Illinois Valley, Oregon and Scott Valley, California, recovery actions identify securing adequate instream flow for coho salmon as a top priority.

Mineral Withdrawal
Gold mining has increased dramatically in the ESU due to increasing gold prices. The California suction dredge ban has caused miners to flock to Oregon where dredging in coho streams has increased. Placer miners destroy riparian forests and dig pits along coho streams with impunity because of the lax federal General Mining Law of 1872 and lax BLM regulations. The Chetco River was slated for intensive suction dredging but a mineral withdrawal spurred by Wild and Scenic designation appears to have ended this threat. We recommend that the NMFS identify specific streams with high IP and high mining claim densities (e.g. Sucker Creek, Althouse Creek, and Galice Creek in the Rogue Basin). The NMFS would then recommend to BLM that these streams be withdrawn from mineral entry to conserve coho salmon habitat and allow effective restoration. Claimants on BLM lands are preventing large wood placement in Althouse Creek in the Illinois Valley and routinely remove habitat wood in Sucker Creek. Placer mining appears incompatible with coho salmon restoration and recovery.

Appropriate Spatial Scale for Habitat Restoration
We agree that the spatial scale for species recovery are the populations delineated in Figure 2-4. Habitat recovery at this scale is problematic because of the large area covered and its inherent heterogeneity over many hundreds of square miles of habitat. We recommend that the fundamental unit for habitat recovery be the 5th field watershed scale and important individual spawning populations be identified at the 6th or 7th field spatial scale for intensive habitat protection/restoration. Analysis in FEMAT 1993, Firman et al. 2011, and Williams et al. 2011b provides a sound scientific basis for restoration of habitat at smaller spatial scales than the

population scales identified. Profiles for each population (Volume II) are necessary, however, to provide the context for habitat recovery at smaller watershed scales.

Beaver

In Oregon, beaver are present in most if not all SONCC watersheds with high IP. Unfortunately beaver are at relatively low densities and beaver dams are rare. Research and monitoring is needed to better understand population dynamics and behavior. In general, translocations of beaver are not recommended because beaver are already present. Beaver are often unknown to landowners and even fisheries managers because beaver seek secluded off-channel areas for dam building. We agree with ODFW that its far better to keep the beaver where they are doing good and provide technical advice and solutions for landowner conflicts. We recommend outreach and education to land owners be emphasized. Funds and technical support are also needed to provide fencing for landowners wishing to protect trees Funds are needed to develop beaver excluders for culverts that also pass migrating adult coho.

Aquatic Conservation Strategy

Currently the SONCC Coho Plan (p.3-48) merely describes the Northwest Forest Plan (NWFP 1994) and its Aquatic Conservation Strategy (ACS) as it applies to federal lands. We recommend that the ACS and its Standards and Guidelines be explicitly identified as the best available science for protecting and restoring coho habitat throughout the entire ESU (Lanigan 2011; Reeves et al. 2006; FEMAT 1993; USFS and USBLM no date). Reasons for this recommendation are: 1) logging and road building have been identified as major factors contributing to the decline of SONCC coho; 2) the NMFS has previously reviewed the Northwest Forest Plan and found it adequate for protecting and restoring the federally listed SONCC coho salmon (NMFS 1997a, NMFS1997b); 3) NMFS has found both the Oregon Forest Practices Act and California's Anadromous Salmonid Protection Rules to be deficient in protecting and restoring coho salmon habitat (p.1-6); 4) the current draft Recovery Plan provides no science based quantitative standards for riparian vegetation protection/restoration; 5) the current draft Recovery Plan fails to identify a system of key watersheds or refugia within designated population areas to focus habitat restoration; 6) assessments at the population scale (Volume II) are necessary but the population area is too large to provide adequate technical detail and management needs at 5th field, 6th field and 7th field watershed scales; 7) the ACS is identified as *guidance* for planning purposes on non-federal lands and not intended to be legally binding or "required" (see p.i Disclaimer). We have edited the ACS to make it more relevant to the Recovery Plan and added recent scientific citations. We suggest including the following ACS sections as guidance to precede the Population Profiles (Volume 2) of the Recovery Plan. In other words, the ACS would provide a strategy for implementing recovery actions.

The Aquatic Conservation Strategy was developed to stabilize and recover imperiled fishes and to work in tandem with recovery efforts for the northern spotted owl. The strategy employs several tactics to approach the goal of maintaining the "natural" disturbance regime (Burnett et al. 2007). Land use activities need to be limited or excluded in those parts of the watershed prone to instability. The distribution of land use activities, such as timber harvest or roads, must minimize increases in peak stream flows and sediment. Headwater riparian areas need to be protected, so that when debris slides and debris flows occur they contain coarse woody debris and coarse sediments necessary for creating habitat farther downstream. Riparian areas along larger channels need protection to limit bank erosion, ensure an adequate and continuous supply of coarse wood to channels, and provide shade and microclimate protection. Watersheds currently containing the best habitat or those with the greatest potential for recovery should receive increased protection and receive highest priority for restoration. The Aquatic Conservation Strategy is implemented with four integral components: Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration. These components are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems to meet Aquatic Conservation Strategy Objectives.

1. Aquatic Conservation Strategy Objectives

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.
2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.
3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.
4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.
5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.
6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.
7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.
8. Maintain and restore the species composition and structural diversity of vegetation in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.
9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

2. Riparian Reserves

Riparian Reserves include those portions of a watershed directly coupled to streams and rivers, that is, the portions of a watershed required for maintaining hydrologic, geomorphic, and ecologic processes that directly affect standing and flowing waterbodies such as lakes and ponds, wetlands, streams, stream processes, and fish habitats. Riparian Reserves occur at the margins of standing and flowing water, intermittent stream channels and ephemeral ponds, and wetlands. Riparian Reserves generally parallel the stream network but also include other areas necessary for maintaining hydrologic, geomorphic, and ecologic processes.

Interim widths for Riparian Reserves necessary to meet Aquatic Conservation Strategy objectives for different waterbodies are established based on ecologic and geomorphic factors. These widths are designed to provide a high level of fish habitat and riparian protection until watershed and site analysis can be completed. Watershed analysis will identify critical hillslope, riparian, and channel processes that must be evaluated to delineate Riparian Reserves that assure protection of riparian and aquatic functions Although Riparian Reserve boundaries may be adjusted on permanently-flowing streams, the prescribed widths are considered to approximate those necessary for attaining Aquatic Conservation Strategy objectives. Post-watershed analysis Riparian Reserve boundaries for permanently-flowing streams should approximate the boundaries prescribed in these standards and guidelines. However, post-watershed analysis Riparian Reserve boundaries for intermittent streams may be different from the existing boundaries. The reason for the difference is the high variability of hydrologic, geomorphic and ecologic processes in a watershed affecting intermittent streams.

3. Riparian Reserve Widths

Fish-bearing streams - Riparian Reserves consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream channel), whichever is greatest.

Permanently flowing non-fish bearing streams - Riparian Reserves consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.

Seasonally flowing or intermittent streams, wetlands less than 1 acre, and unstable and potentially unstable areas - This category applies to features with high variability in size and site-specific characteristics. At a minimum, the Riparian Reserves must include:

- The extent of unstable and potentially unstable areas (including earthflows),
- The stream channel and extend to the top of the inner gorge,
- The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation, and extension from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest.

A site-potential tree height is the average maximum height of the tallest dominant trees (200 years or older) for a given site class. Intermittent streams are defined as any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria.

4. Standards and Guidelines for Riparian Reserves

As a general rule, standards and guidelines for Riparian Reserves prohibit or regulate activities in Riparian Reserves that retard or prevent attainment of the Aquatic Conservation Strategy objectives.

5. Forest Management

TM-1. Prohibit tree cutting, timber harvest, and fuelwood cutting in Riparian Reserves, except as described below.
a. Where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuelwood cutting if required to attain Aquatic Conservation Strategy objectives.
b. Salvage trees only when watershed analysis determines that present and future coarse woody debris needs are met and other Aquatic Conservation Strategy objectives are not adversely affected.
c. Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives.

6. Roads Management

RF-1. Federal, state, county agencies and private owners should cooperate to achieve consistency in road design, operation, and maintenance necessary to attain Aquatic Conservation Strategy objectives.
RF-2. For each existing or planned road, meet Aquatic Conservation Strategy objectives by:
a. minimizing road and landing locations in Riparian Reserves.
b. completing watershed analyses (including appropriate geotechnical analyses) prior to construction of new roads or landings in Riparian Reserves.
c. preparing road design criteria, elements, and standards that govern construction and reconstruction.
d. preparing operation and maintenance criteria that govern road operation, maintenance, and management.
e. minimizing disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow.
f. restricting sidecasting as necessary to prevent the introduction of sediment to streams.
g. avoiding wetlands entirely when constructing new roads.
RF-3. Determine the influence of each road on the Aquatic Conservation Strategy objectives through watershed analysis. Meet Aquatic Conservation Strategy objectives by:
a. reconstructing roads and associated drainage features that pose a substantial risk.
b. prioritizing reconstruction based on current and potential impact to riparian resources and the ecological value of the riparian resources affected.
c. closing and stabilizing, or obliterating and stabilizing roads based on the ongoing and potential effects to Aquatic Conservation Strategy objectives and considering short-term and long-term transportation needs.
RF-4. New culverts, bridges and other stream crossings shall be constructed, and existing culverts, bridges and other stream crossings determined to pose a substantial risk to riparian conditions will be improved, to accommodate at least the 100-year flood, including associated bedload and debris. Priority for upgrading will be based on the potential impact and the ecological value of the riparian resources affected. Crossings will be constructed and maintained to prevent diversion of streamflow out of the channel and down the road in the

event of crossing failure (i.e. “stormproofing”).
RF-5. Minimize sediment delivery to streams from roads by disconnecting road runoff from the stream system. Outsloping of the roadway surface is preferred, except in cases where outsloping would increase sediment delivery to streams or where outsloping is unfeasible or unsafe. Route road drainage away from potentially unstable channels, fills, and hillslopes.
RF-6. Provide and maintain upstream and downstream fish passage at all road crossings of existing and potential fish-bearing streams.
RF-7. Develop and implement a Road Management Plan or a Transportation Management Plan that will meet the Aquatic Conservation Strategy objectives. As a minimum, this plan shall include provisions for the following activities:
a. inspections and maintenance during storm events.
b. inspections and maintenance after storm events.
c. road operation and maintenance, giving high priority to identifying and correcting road drainage problems that contribute to degrading riparian resources.
d. traffic regulation during wet periods to prevent damage to riparian resources.
e. establish the purpose of each road by developing the Road Management Objective.

7. Grazing Management

GM-1. Adjust grazing practices to eliminate impacts that retard or prevent attainment of Aquatic Conservation Strategy objectives. If adjusting practices is not effective, eliminate grazing.
GM-2. Locate new livestock handling and/or management facilities outside Riparian Reserves. For existing livestock handling facilities inside the Riparian Reserve, ensure that Aquatic Conservation Strategy objectives are met. Where these objectives cannot be met, relocate or remove such facilities.
GM-3. Limit livestock trailing, bedding, watering, loading, and other handling efforts to those areas and times that will ensure Aquatic Conservation Strategy objectives are met.

8. Development Management

RM-1. New structures and facilities within Riparian Reserves (e.g., homes, storage building, gazebos, gardens, boat launches, trails and dispersed sites) should be designed to not prevent meeting Aquatic Conservation Strategy objectives. Construction of these facilities should not prevent future attainment of these objectives. For existing facilities within Riparian Reserves, evaluate and mitigate impact to ensure that these do not prevent attainment of Aquatic Conservation Strategy objectives.
RM-2. Adjust dispersed and developed recreation practices that retard or prevent attainment of Aquatic Conservation Strategy objectives. Where adjustment measures such as education, use limitations, traffic control devices, increased maintenance, relocation of facilities, and/or specific site closures are not effective, eliminate the practice or occupancy.
RM-3. Wild and Scenic Rivers, Wilderness management plans, State and County Parks etc. will address attainment of Aquatic Conservation Strategy objectives.

9. Minerals Management

MM-1. Require a reclamation plan, approved Plan of Operations, and reclamation bond for all minerals operations that include Riparian Reserves. Such plans and bonds must address the costs of removing facilities, equipment, and materials; recontouring disturbed areas to near pre-mining topography; isolating and neutralizing or removing toxic or potentially toxic materials; salvage and replacement of topsoil; and seedbed preparation and revegetation to meet Aquatic Conservation Strategy objectives.

MM-2. Locate structures, support facilities, and roads outside Riparian Reserves. Where no alternative to siting facilities in Riparian Reserves exists, locate them in a way compatible with Aquatic Conservation Strategy objectives. Road construction will be kept to the minimum necessary for the approved mineral activity. Such roads will be constructed and maintained to meet roads management standards and to minimize damage to resources in the Riparian Reserve. When a road is no longer required for mineral or land management activities, it will be closed, obliterated, and stabilized.

MM-3. Prohibit solid and sanitary waste facilities in Riparian Reserves. If no alternative to locating mine waste (waste rock, spent ore, tailings) facilities in Riparian Reserves exists, and releases can be prevented, and stability can be ensured, then:

a. analyze the waste material using the best conventional sampling methods and analytic techniques to determine its chemical and physical stability characteristics

b. locate and design the waste facilities using best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials. If the best conventional technology is not sufficient to prevent such releases and ensure stability over the long term, prohibit such facilities in Riparian Reserves.

c. monitor waste and waste facilities after operations to ensure chemical and physical stability and to meet Aquatic Conservation Strategy objectives.

d. reclaim waste facilities after operations to ensure chemical and physical stability and to meet Aquatic Conservation Strategy objectives.

e. require reclamation bonds adequate to ensure long-term chemical and physical stability of mine waste facilities—including the cost of perpetual treatment of potential acid mine drainage (e.g., see Woody et al. 2010).

MM-4. For leasable minerals, prohibit surface occupancy within Riparian Reserves for oil, gas, and geothermal exploration and development activities where leases do not already exist. Where possible, adjust the operating plans of existing contracts to eliminate impacts that retard or prevent the attainment of Aquatic Conservation Strategy objectives.

MM-5. Salable mineral activities such as sand and gravel mining and extraction within Riparian Reserves will occur only if Aquatic Conservation Strategy objectives can be met.

MM-6. Include inspection and monitoring requirements in mineral plans, leases or permits. Evaluate the results of inspection and monitoring to effect the modification of mineral plans, leases and permits as needed to eliminate impacts that retard or prevent attainment of Aquatic Conservation Strategy objectives.

10. Fire/Fuels Management

FM-1. Design fuel treatment and fire suppression strategies, practices, and activities to meet Aquatic Conservation Strategy objectives, and to minimize disturbance of riparian ground cover and vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuels management activities could be

damaging to long-term ecosystem function.
FM-2. Locate incident bases, camps, helibases, staging areas, helispots and other centers for incident activities outside Riparian Reserves.
FM-3. Minimize delivery of chemical retardant, foam, or additives to surface waters.
FM-4. Design prescribed burn projects and prescriptions to contribute to attainment of Aquatic Conservation Strategy objectives.
FM-5. Immediately establish an emergency team to develop a rehabilitation treatment plan needed to attain Aquatic Conservation Strategy objectives whenever Riparian Reserves are significantly damaged by wildfire or a prescribed fire burning outside prescribed parameters.

In Riparian Reserves, the goal of wildfire suppression is to limit the size of all fires.
In Riparian Reserves, water drafting sites should be located and managed to minimize adverse effects on riparian habitat and water quality.

11. Lands

LH-1. Identify in-stream flows needed to maintain riparian resources, channel conditions, and fish passage.
LH-2. Key Watersheds: For hydroelectric and other surface water development proposals, require in-stream flows and habitat conditions that maintain or restore riparian resources, favorable channel conditions, and fish passage. Coordinate this process with the appropriate state agencies. During relicensing of hydroelectric projects, provide written and timely license conditions to the Federal Energy Regulatory Commission (FERC) that require flows and habitat conditions that maintain or restore riparian resources and channel integrity. Coordinate relicensing projects with the appropriate state agencies.
For all other watersheds: For hydroelectric and other surface water development proposals, give priority emphasis to in-stream flows and habitat conditions that maintain or restore riparian resources, favorable channel conditions, and fish passage. Coordinate this process with the appropriate state agencies. During relicensing of hydroelectric projects, provide written and timely license conditions to FERC that emphasize in-stream flows and habitat conditions that maintain or restore riparian resources and channel integrity. Coordinate relicensing projects with the appropriate state agencies.
LH-3. Locate new support facilities outside Riparian Reserves. For existing support facilities inside Riparian Reserves that are essential to proper management, provide recommendations to FERC that ensure Aquatic Conservation Strategy objectives are met. Where these objectives cannot be met, provide recommendations to FERC that such support facilities should be relocated. Existing support facilities that must be located in the Riparian Reserves will be located, operated, and maintained with an emphasis to eliminate adverse effects that retard or prevent attainment of Aquatic Conservation Strategy objectives rights-of-way, and easements to avoid adverse effects that retard or prevent attainment of Aquatic Conservation Strategy objectives. Adjust existing leases, permits, rights-of-way, and easements to eliminate adverse effects that retard or prevent the attainment of Aquatic Conservation Strategy objectives. If adjustments are not effective, eliminate the activity. Priority for modifying existing leases, permits, rights-of-way and easements will be based on the actual or potential impact and the ecological value of the riparian resources affected.
LH-5. Use land acquisition, exchange, and conservation easements to meet Aquatic Conservation Strategy objectives and facilitate restoration of fish stocks and other species at risk of extinction.

12. General Riparian Area Management

RA-1. Identify and attempt to secure in-stream flows needed to maintain riparian resources, channel conditions, and aquatic habitat.
RA-2 Fell trees in Riparian Reserves when they pose a safety risk. Keep felled trees on-site when needed to meet coarse woody debris objectives.
RA-3. Herbicides, insecticides, and other toxicants, and other chemicals shall be applied only in a manner that avoids impacts that retard or prevent attainment of Aquatic Conservation Strategy objectives.
RA-4. Locate water drafting sites to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat.

13. Watershed and Habitat Rehabilitation

WR-1. Design and implement watershed rehabilitation projects in a manner that promotes long-term ecological integrity of ecosystems, conserves the genetic integrity of native species, and attains Aquatic Conservation Strategy objectives.
WR-2. Cooperate with federal, state, local, and tribal agencies, and private landowners to develop watershed-based Coordinated Resource Management Plans or other cooperative agreements to meet Aquatic Conservation Strategy objectives.
WR-3. Do not use mitigation or planned rehabilitation as a substitute for preventing habitat degradation.

14. Fish and Wildlife Management

FW-1. Design and implement fish and wildlife habitat restoration and enhancement activities in a manner that contributes to attainment of Aquatic Conservation Strategy objectives.
FW-2. Design, construct and operate fish and wildlife interpretive and other user-enhancement facilities in a manner that does not retard or prevent attainment of Aquatic Conservation Strategy objectives. For existing fish and wildlife interpretative and other user-enhancement facilities inside Riparian Reserves, ensure that Aquatic Conservation Strategy objectives are met. Where Aquatic Conservation Strategy objectives cannot be met, relocate or close such facilities.
FW-3. Cooperate with federal, tribal, and state wildlife management agencies to identify and eliminate wild ungulate impacts that are inconsistent with attainment of Aquatic Conservation Strategy objectives.
FW-4. Cooperate with federal, tribal, and state fish management agencies to identify and eliminate impacts associated with habitat manipulation, fish stocking, harvest and poaching that threaten the continued existence and distribution of native fish stocks occurring on federal lands.

15. Research

RS-1. A variety of research activities may be ongoing and proposed in Key Watersheds and Riparian Reserves. These activities must be analyzed to ensure that significant risks to the watershed values do not exist. If significant risk is present and cannot be mitigated, study sites must be relocated. Some activities not otherwise consistent with the objectives may be appropriate, particularly if the activities will test critical assumptions of these standards and guidelines; will produce results important for establishing or accelerating vegetation and structural characteristics for maintaining or restoring aquatic and riparian ecosystems; or the activities represent continuation of long-term research. These activities should be considered only if there are no equivalent opportunities outside of Key Watersheds and Riparian

Reserves.
RS-2. Current, funded, agency-approved research, which meets the above criteria, is assumed to continue if analysis ensures that a significant risk to Aquatic Conservation Strategy objectives does not exist.

Coho Key Watersheds (Salmon Refuges, Native Fish Conservation Areas, Aquatic Diversity Management Areas)

1. **Basis for Standards and Guidelines**

Refugia are a cornerstone of most species conservation strategies. Williams et al. (2011b) identified four critical elements for watershed scale conservation: (1) maintain processes that create habitat complexity, diversity and connectivity;(2) nurture all of the life history stages of the fishes being protected; (3) include a large enough watershed to provide long-term persistence of native fish populations and (4) provide management that is sustainable over time. A system of Coho Key Watersheds that serve as refugia is crucial for maintaining and recovering habitat for SONCC coho salmon within core areas. The Coho Key Watersheds would include areas of high quality habitat as well as areas of degraded habitat. Coho Key Watersheds with high quality conditions will serve as anchors for the potential recovery of depressed populations segments within core population areas. Those areas of lower quality habitat with a high potential or capacity for restoration and will become future sources of high quality habitat with the implementation of a comprehensive restoration program (Frissell et al. 1997).

We recommend that 5th field watersheds with relatively high amounts of high intrinsic potential coho habitat and relatively high spawner counts be identified in the Recovery Plan as Key Coho Watersheds. For example, in the Illinois Basin, Sucker Creek, Deer Creek, upper East Fork Illinois River, Elk Creek and possibly Althouse Creek would be identified as Coho Key Watersheds to support core area designation in the Recovery Plan (p. 30-6). Within Coho Key Watersheds we recommend that sufficient 6th or 7th field sub-watersheds be identified as Coho Key Spawning Watersheds. Likely candidates as Key Spawning Coho Watershed would be small watersheds of "key" streams listed in Table 41-1. Mainstem areas of 5th field watersheds are often too unstable for successful spawning by coho because of instability of gravel beds during winter peak flows (Nawa and Frissell 1997). Thus, it is common to find high concentrations of coho spawning in only a few tributaries of 5th field watersheds or in spring fed side channels buffered from bedload movement. Some portion of juveniles migrate to mainstem areas suitable for rearing or seek out other tributary reaches. These relatively small 6th and 7th field sub-watersheds would be high priority areas for intensive road decommissioning and grazing reduction. Kaufmann and Hughes (2006) reported that road density was significantly associated with lower fish assemblage condition in Coast Range streams of Oregon and Washington. A review by Carnefix and Frissell (2009) found that it is more effective to reduce road densities to very low densities in select watersheds than to reduce high road densities to only moderate levels. A road density effect on coho salmon was corroborated by Firman et al. (2011) who found that "[p]redictor variables indicative of land management, cattle density, and road density were negatively associated with peak spawner densities in many of our models." The coho populations studied were spawning in 7th field watersheds. This is important because reducing road densities is extremely costly. Reducing roads to very low densities in 6th and 7th field Coho Key Spawning Watersheds would be far more practical and effective than attempting to reduce road densities in Recovery Plan "population" areas that are many times larger. The point is to concentrate road density reductions where they will be most effective.

2. Standards and Guidelines

Coho Key Watersheds are highest priority for watershed restoration.
No new roads would be built in Coho Key Watersheds.
Road Densities in Coho Key Spawning Watersheds would be reduced to 0-0.5/mi^2.
Grazing would be reduced or eliminated in Coho Key Spawning Watersheds.
Watershed analysis is required prior to major ground disturbing management activities such as timber harvest in Coho Key Watersheds.

3. Watershed Analysis

The population assessments in the Recovery Plan (Volume II) are necessary for evaluating issues pertaining to populations at risk of extinction but the spatial scale (300-600 mi^2) for population evaluation is generally too large for technically detailed watershed analysis of 5^{th} field watersheds designed to efficiently protect and restore habitat. For example, the Illinois River Population (Chapter 30) covers an estimated 400 mi^2 of the upper portion of the 660 mi^2 basin. The Illinois River population assessment only generalizes about limiting factors affecting the larger 5^{th} field streams. Dozens of named and unnamed streams containing substantial coho salmon are not assessed. For example, the ephemeral Scotch Gulch tributary to East Fork Illinois River has dozens of coho spawners each year but its importance or conservation needs remain unrecognized (fortunately its owners have placed it in a conservation easement). Important information such as erosion hazard and highly erosive soils in important coho spawning streams such as Grayback Creek are not described or mapped. This is important because Firman et al. (2011) found that on the Oregon Coast, lower coho spawner densities were correlated with erosive "weak" rock types. Similarly, Kaufmann and Hughes (2006) reported for the Oregon and Washington Coast Range that fish assemblage condition was generally lower in sedimentary lithology than in volcanic lithology. Numerous assessments in the Recovery Plan identify sediment reduction as an issue, and as part of USEPA's development of national sediment criteria, Bryce et al. (2008; 2010) reported that fine sediments reduced fish and benthos assemblage condition and salmonids in western USA mountain streams. We believe that the Recovery Plan could provide much better habitat assessments and recommendations for coho salmon if existing 5^{th} field watershed analyses (e.g., USDI-BLM 2000;USDI-BLM 2003;USDI-BLM 1997) were updated with an emphasis on coho salmon recovery and watershed analysis (as described below) were fully developed for smaller watersheds that currently lack watershed analyses (Table 41-4, Section 41:4).

Watershed analysis has a critical role in providing for aquatic and riparian habitat protection. In planning for ecosystem management and establishing Riparian Reserves to protect and restore riparian and aquatic habitat, the overall watershed condition and the array of processes operating there need to be considered. Watershed condition includes more than just the state of the channel and riparian area. It also includes the condition of the uplands, distribution and type of seral classes of vegetation, land use history, effects of previous natural and land-use related disturbances, and distribution and abundance of species and populations throughout the watershed. These factors strongly influence the structure and functioning of aquatic and riparian habitat. Effective protection strategies for riparian and aquatic habitat must accommodate the wide variability in landscape conditions present within selected population areas. Watershed analysis plays a key role in the Aquatic Conservation Strategy, ensuring that aquatic system protection is fitted to specific landscapes.

Watershed analysis will focus on collecting and compiling information within the watershed that is essential for making sound management decisions. It will be an analytical process. It will serve as the basis for developing project-specific proposals, and monitoring and restoration needs for a watershed. Some analysis of issues or resources may be included in broader scale analyses because of their scope (e.g., Population profiles in current Recovery Plan). The information from watershed analysis will be used to develop priorities for funding, and implementing actions and projects, and will be used in developing monitoring strategies and objectives. The participation of adjacent landowners, private citizens, interest groups, industry, various government agencies, and others in watershed analyses will be promoted. Watershed analysis is a systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. This information will support decisions for implementing management prescriptions, including setting and refining boundaries of Riparian Reserves and other reserves, developing restoration strategies and priorities, and revealing the most useful indicators for monitoring environmental changes. It is a key component supporting watershed planning and analyzing the blending of social expectations with the biophysical capabilities of specific landscapes. Watershed analysis is the appropriate level for analyzing the effects of transportation systems on aquatic and riparian habitats within the target watershed.

Watershed analysis consists of technically rigorous and defensible procedures designed to identify processes that are active within a watershed, how those processes are distributed in time and space, the current upland and riparian conditions of the watershed, and how all of these factors influence riparian habitat and other beneficial uses. The analysis is conducted by an interdisciplinary team consisting of geomorphologists, hydrologists, soil scientists, biologists and other specialists as needed. Information used in this analysis includes: maps of topography, stream networks, soils, vegetation, and geology; sequential aerial photographs; field inventories and surveys including landslide, channel, aquatic habitat, and riparian condition inventories; census data on species presence and abundance; water quality data; disturbance and land use history; and other historical data (e.g., streamflow records, old channel surveys).

Watershed analysis is organized as a set of modules that examine biotic and abiotic processes influencing aquatic habitat and species abundance (e.g., landslides, surface erosion, peak and low streamflows, stream temperatures, road network effects, coarse woody debris dynamics, channel processes, fire, limiting factor analysis for key species). Results from these modules are integrated into a description of current upland, riparian, and channel conditions; maps of location, frequency, and magnitude of key processes; and descriptions of location and abundance of key species.

Watershed analysis provides the contextual basis at the site level for decision makers to set appropriate boundaries of Riparian Reserves, plan land use activities compatible with disturbance patterns, design road transportation networks that pose minimal risk, identify what and where restoration activities will be most effective, and establish specific parameters and activities to be monitored. More detailed site-level analysis is conducted to provide the information and designs needed for specific projects (e.g., road siting or timber sale layout) so that riparian and aquatic habitats are protected. Watershed analysis provides the ecologic and geomorphic basis for changing the size and location of Riparian Reserves necessary to meet Aquatic Conservation Strategy objectives.

Within a given physiographic province, similar geographic and topographic features control drainage network and hillslope stability patterns. These features may exert a strong influence on the design of Riparian Reserves. For example, in the highly dissected southern Oregon Coast Range, debris flows originating in channel heads are the primary mass movement process. Large, slow-moving earthflows are dominant in the northern California coast. Earthflows qualify as unstable and potentially unstable areas and would be analyzed for inclusion within Riparian Reserves for intermittent streams. To adequately protect the aquatic system from management induced landsliding, Riparian Reserve design may vary as a result of these differences. In the Oregon Coast Range, Riparian Reserves would tend to be in narrow bands associated with intermittent streams, relatively evenly distributed throughout the basin, while those in the Northern California coast may be locally extensive and centered around earthflows. Stable areas in other parts of the watershed may have reduced Riparian Reserves on intermittent streams.

Earthflows can cover extensive amounts of land within a watershed. As such, they largely influence the resulting landscape and directly affect aquatic and riparian habitat quality, structure and function. For example, streams flowing through active earthflows would tend to cut the toes of the inner gorges. Thus, the earthflow would serve as a chronic source of sediment to the channel. The effects of constructing roads or harvesting timber on the rate of sediment delivery to the channel on the earthflow would need to be considered during the design of the Riparian Reserve. Thus, the amount of a particular earthflow incorporated into a Riparian Reserve, as identified through watershed analysis, depends on the risk of management-induced disturbances and meeting Aquatic Conservation Strategy objectives. The risk will be determined based on an analysis of the projected instability of the earthflow relative to the recovery rate of aquatic and riparian ecosystems. There will be cases where entire earthflows will be incorporated into Riparian Reserves and cases where only those portions determined to directly affect the rate of achieving Aquatic Conservation Strategy objectives will be incorporated.

The efficacy of many previous analyses at the watershed level suffered from unclear logic used in weighting or combining individual elements, reliance on simple indices to explain complex phenomena, and assumptions of direct or linear relations between land use intensity and watershed response. These previous watershed analyses typically did not consider how key processes are distributed over watersheds within a given landscape and, in many cases, did not distinguish between physiographic provinces, which can vary widely in the importance of individual processes. Furthermore, most of the previous approaches lacked any method to validate their assumptions or results.

4. Watershed Restoration

Watershed restoration will be an integral part of a program to aid recovery of fish habitat, riparian habitat, and water quality. Restoration will be based on watershed analysis and planning. Watershed analysis is essential to identify areas of greatest benefit-to-cost relationships for restoration opportunities and greatest likelihood of success (e.g., reducing road densities in smaller watershed areas upslope of spawning coho salmon). Watershed analysis can also be used as a medium to develop cooperative projects involving various landowners. In many watersheds the most critical restoration needs occur on private lands downstream from federally managed lands. Decisions to apply a given treatment depend on the value and sensitivity of downstream uses, transportation needs, social expectations, risk assessment of probable outcomes for success at correcting problems, costs, and other factors. Watershed analysis, including the use of sediment budgets, provides a framework for considering benefit-to-cost relations in a watershed context. Thus, the magnitude of restoration needs within the planning area will be based on watershed analysis.

The most important components of a watershed restoration program are control and prevention of road-related runoff and sediment production, restoration of riparian vegetation, restoration of in-stream habitat complexity, removal of artificial migration barriers, mine reclamation, and restoration of historic flows.

5. Roads

Road treatments range from full decommissioning (closing and stabilizing a road to eliminate potential for storm damage and the need for maintenance) to simple road upgrading, which leaves the road open. Upgrading can involve practices such as removing soil from locations where there is a high potential of triggering landslides, modifying road drainage systems to reduce the extent that the road functions as an extension of the stream network, and reconstructing stream crossings to reduce the risk and consequences of road failure or washing out at the crossings.

The decision to apply a given treatment depends on the value and sensitivity of downstream uses, transportation needs, social expectations, assessment of probable outcomes for success at correcting problems, costs, and other factors. Watershed analysis, including the use of sediment budgets, provides a framework for considering benefit-to-cost relations in a watershed context. Thus, the magnitude of regional restoration needs will be based on watershed analysis.

6. Riparian Vegetation

Active silvicultural programs will be necessary to restore large conifers in Riparian Reserves. Appropriate practices may include planting unstable areas such as landslides along streams and flood terraces, thinning densely-stocked young stands to encourage development of large conifers, releasing young conifers from overtopping hardwoods, and reforesting shrub and hardwood-dominated stands with conifers. These practices can be implemented along with silvicultural treatments in uplands areas, although the practices will differ in objective and, consequently, design.

7. In-Stream Habitat Structures

In-stream restoration, based on the interpretation of physical and biological processes and deficiencies during watershed analysis, can be an important component of an overall program for restoring fish and riparian habitat. In-stream restoration measures are inherently short term and must be accompanied by riparian and upslope restoration to achieve long-term watershed restoration. Maintaining desired levels of channel habitat complexity, for example, may best be achieved in the short term by introducing structures. However, a riparian area with the complete array of functions and processes should provide coarse woody debris to the channel in the long term.

Typically, rehabilitation actions are planned and implemented at the site or reach scale; however, to be effective they must be planned and integrated at the catchment or basin scale, with a focus on recovering potential natural vegetation, naturalized flow regimes, physical habitat structure, and water quality (Frissell and Nawa 1992; Muhar 1996; Poff et al. 1997; Jansson et al. 2007). Therefore, the suggested priority actions are: 1) protect existing high quality catchments and habitats, and 2) reestablish ecosystem processes and connectivity to natural levels in altered habitats and catchments (especially water quality and flow regime)—before attempting to rehabilitate degraded instream hydromorphology at the reach scale (NRC 1992; 1996; Roni et al. 2002; 2008; Beechie et al. 2008).

In-stream restoration must be accompanied by riparian and upslope restoration if watershed restoration is to be successful. In-stream restoration, including in-channel structures, will not be used to mitigate for management actions that degrade existing habitat, as a substitute for habitat protection, or to justify risky land management activities and practices (Frissell and Nawa 1992) . Priority must be given to protecting existing high quality habitat.

8. Summary of Aquatic Conservation Strategy for Watershed Restoration:
Watershed restoration restores watershed processes to recover degraded habitat.
Watershed restoration should focus on removing and upgrading roads.
Silvicultural treatments may be used to restore large conifers in Riparian Reserves.
Watershed restoration should restore channel complexity. In-stream structures should only be used in the short term and not as a mitigation for poor land management practices.

Adaptive Management

By adaptive management we mean the fully experimental approach envisioned by the NRC (2004) and NMFS (2004). Adaptive management (AM) has had a mixed record, mainly because of institutional resistance to its proper implementation and because many agencies use the term too loosely. The purpose of AM is often misconstrued as calling for further study and delay of action, whereas it really means undertaking actions with every intent of achieving stated goals, but acknowledging that the path to, and achievability of, those goals is unclear from the outset. Thus, AM places accountability about the outcome of a program at the level of achieving goals, whereas most large rehabilitation programs aim any accountability at ensuring that the actions themselves are completed, irrespective of their effectiveness.

Adaptive management requires both: (1) an explicit statement of expectations in the form of models, metrics, and monitoring to evaluate progress; and (2) explicit loops from the synthesis of data and examination of outcomes back to all of the decision points. This process forces managers to think about how to measure and report performance, and how to determine when an action is or is not working as expected. Thus, the key elements that distinguish adaptive management from most other kinds of management are:

1. Explicit stepwise statements of problems and goals, with check-in points and the spectrum of alternatives at branch points or trigger points specified in advance.

2. Clear conceptual models of processes to be affected, and simulation models where data can support them.

3. Clear expectations of outcomes of the action and potential alternatives, with multiple performance measures and indicators; predictions may be based on simulation modeling.

4. Rigorously designed pre-project and post-project monitoring programs with embedded analysis for evaluating progress and selecting alternative or revised actions. The catchment-scale monitoring should not only focus on target fish populations, but should include periodic rigorous assessments of ecosystem condition via probability sampling of fish and macroinvertebrate assemblages, productivity, and physical and chemical habitat monitored through use of standard field methods (e.g., Anlauf et al. 2011; Hughes and Peck 2008; Paulsen et al. 2008).

5. An adequately funded team charged with evaluating results and making recommendations for revising goals, desired outcomes, models, and actions, with a strong Lead Scientist responsible and accountable for carrying out this program. It is essential to the success of this program that this team and the Lead Scientist begin work well in advance of the actual rehabilitation.

6. A lead agency with the authority, funding, and will to maintain the process and make changes recommended by the evaluation team. To institute adaptive management for the Proposed Action will require that scientific leadership be given a prominent role in program design and implementation. The Lead Scientist would be responsible to coordinate and promote monitoring and research, and to explain the implications of scientific findings to decision-makers and the public. Duties of the scientific program, based on experience in other large programs, would include:

   Fostering open and broad discussion of scientific issues;
   Facilitating effective peer review of key documents;
   Providing status and trend "report cards" or similar evaluation documents for decision makers and the public;
   Building and maintaining openly available databases; and
   Maintaining and updating conceptual and simulation models for ongoing analysis and assessment.

7. For the rehabilitation program to be truly effective in achieving its goals, a budget for monitoring, data management and analysis, assessment, research, and reporting should be commensurate with the magnitude of the program and the pervasiveness of uncertainty. A budget on the order of 10 percent of the cost of the program would not be excessive.

LITERATURE CITED

Adams, P.B., L.B. Boydstun, S.P. Gallagher, M.K. Lacy, T. McDonald, and K.E. Shaffer. 2011. California coastal salmonid population monitoring: strategy, design, and methods. Fish Bulletin 180. State of California, The Natural Resources Agency, Department of Fish and Game. 80 p

Alexander, G. G., and J. D. Allan. 2006. Stream restoration in the upper Midwest, U.S.A. Restoration Ecology 14:595–604.

Alsbury, T. 2012. Colonization of coho salmon above natural barrier falls in Oregon: a history of supplementation and the expansion of coho salmon range above Willamette falls. Abstract. Oregon Chapter American Fisheries Society Annual Meeting Eugene, Oregon.

Anlauf, K.J., W. Gaeuman, and K.K. Jones. 2011. Detection of regional trends in salmonid habitat in coastal streams, Oregon. Transactions of the American Fisheries Society 140:52-66.

Beechie, T., G. Pess, P. Roni, and G. Giannico. 2008. Setting river restoration priorities: a review of approaches and a general protocol for identifying and prioritizing actions. North American Journal of Fisheries Management 28:891–905.

Bernhardt, E. S., M. A. Palmer, J. D. Allan, G. Alexander, K. Barnas, S. Brooks, J. Carr, S. Clayton, C. Dahm, J. Follstad-Shah, D. Galat, S. Gloss, P. Goodwin, D. Hart, B. Hassett, R. Jenkinson, S. Katz, G. M. Kondolf, P. S. Lake, R. Lave, J. L. Meyer, T. K. O'Donnell, L. Pagano, B. Powell, and E. Sudduth. 2005. Synthesizing U.S. river restoration efforts. *Science* 308:636 – 637.

Bryce, S.A., G.A. Lomnicky, P.R. Kaufmann, L.S. McAllister, and T.L. Ernst. 2008. Development of biologically based sediment criteria in mountain streams of the western United States. North American Journal of Fisheries Management 28:1714-1724.

Bryce, S.A., G.A. Lomnicky, and P.R. Kaufmann. 2010. Protecting sediment-sensitive aquatic species in mountain streams through the application of biologically based streambed sediment criteria. Journal of the North American Benthological Society 29:657-672.

Carnefix, G. and C. Frissell. 2009. Aquatic and other environmental impacts of roads: the case for road density as indicator of human disturbance and road density reduction as restoration target; a concise review. Pacific River Council Science Publication 09-0001.

Chilcote, M.W., K.W. Goodson, and M.R. Falcy. 2010. Reduced recruitment performance in natural populations of anadromous salmonids associated with hatchery-reared fish. Can. J. Fish. Aquat. Sci. 68: 511-522.

Firman, J.C., E. Ashley Steel and 6 others. 2011. Landscape models of adult coho salmon density examined at four spatial extents. Transactions of the American Fisheries Society 140:440-455.

Follstad-Shah, J. J., C. N. Dahm, S. P. Gloss, and E. S. Bernhardt. 2007. River and riparian restoration in the Southwest: results of the National River Restoration Science synthesis project. Restoration Ecology 15:550–562.

Frissell, C. A. and R.K. Nawa. 1992. Incidence and causes of physical failure of artificial fish habitat structures of streams of western Oregon and Washington. North American Journal of Fisheries Management 12: 182-197.

Frissell, C.A., W.J. Liss, R.E. Gresswell, R.K. Nawa, J.L. Ebersole. 1997. A resource in crisis: changing the measure of salmon management. Pp411-444. In Pacific Salmon and Their Ecosystems. D.J.Stouder, P.A. Bisson, R.J. Naiman, editors. Chapman &Hall

Forest Ecosystem Management Assessment Team (FEMAT). 1993. Forest ecosystem management: an ecological, economic and social assessment. Report of the Forest Ecosystem Management Assessment Team. 1993-793-071. U.S. Govt. Printing Office.

Hassett, B. A., M. A. Palmer, and E. S. Bernhardt. 2007. Evaluating stream restoration in the Chesapeake Bay watershed through practitioner interviews. Restoration Ecology 15:563–572.

Holt, C.A., M.B. Rutherford, R.M. Peterman. In Press. International cooperation among nation-states of the North Pacific Ocean on the problem of competition among salmon for a common pool of prey resources. Marine Policy.

Hughes, R.M., and D.V. Peck. 2008. Acquiring data for large aquatic resource surveys: the art of compromise among science, logistics, and reality. Journal of the North American Benthological Society 27:837-859.

IMST (Independent Multidisciplinary Science Team). 2006. Watershed and aquatic habitat effectiveness monitoring: a synthesis of the technical workshop. IMST Technical Report 2006-1. Oregon Watershed Enhancement Board. Salem, Oregon.

—. 2007a. Considerations for the use of ecological indicators in restoration effectiveness evaluation. IMST Technical Report 2007-1. Oregon Watershed Enhancement Board. Salem, Oregon.

--- 2007b. IMST review of ODFW's draft native fish conservation plan for the spring chinook Salmon: Rogue species management unit (February 28, 2007 draft). Oregon Watershed Enhancement Board, Salem, Oregon.

—. 2009. Issues in the aggregation of data to assess environmental conditions. IMST Technical Report 2009-1. Oregon Watershed Enhancement Board, Salem, Oregon.

--- 2011a. IMST review of Oregon Department of Fish and Wildlife's conservation plan for fall Chinook salmon in the Rogue species management unit (July 8, 2011 draft). Oregon Watershed Enhancement Board, Salem, Oregon.

---. 2011b. IMST Recommendation to the Oregon Department of Fish and Wildlife regarding conservation planning and monitoring (December 1, 2011). Oregon Watershed Enhancement Board, Salem, Oregon.

Jansson, R., C. Nilsson, and B. Malmqvist. 2007. Restoring freshwater ecosystems in riverine landscapes: the roles of connectivity and recovery processes. Freshwater Biology 52: 589–596.

Johnson, R.C., P.K. Weber, J.D. Wikert, M.L. Workman, R.B. MacFarlane, et al. 2012. Managed metapopulations: do salmon hatchery 'sources' lead to in-river'sinks' in conservation? PLoS ONE 7(2): e28880. doi:10.1371/journal.pone.0028880

Katz S.L., K. Barnas, R. Hicks, J. Cowen, and R. Jenkinson. 2007. Freshwater habitat restoration action in the Pacific Northwest: a decade's investment in habitat improvement. Restoration Ecology 15(3): 494–505.

Katz, J. ,P.B. Moyle, R.M. Quinones, J. Israel, S. Purdy. 2012. Impending extinction of salmon, steelhead, and trout (Salmonidae) in California. Environmental Biology of Fishes. http://www.springerlink.com/content/e732l750m54p5r65/abstract/

Kaufmann, P.R., and R.M. Hughes. 2006. Geomorphic and anthropogenic influences on fish and amphibians in Pacific Northwest coastal streams. In R.M. Hughes, L. Wang, and P.W. Seelbach (eds.). Landscape influences on stream habitat and biological assemblages. American Fisheries Society, Symposium 48:429-455.

Lanigan, S.H., S.N. Gordon, P. Eldred, M. Isley, S. Wilcox, C. Moyer, and H.Andersen. 2011. Northwest Forest Plan – the first 15 years (1994-2008): status and trend of watershed condition. Gen. Tech. Rep. PNW-GTR-XXX. Portland, OR:U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Muhar, S. 1996. Habitat improvement of Austrian rivers with regard to different scales. Regulated Rivers: Research and Management 12: 471–482.

Mulvey, M., R. Leferink, and A. Borisenko. 2009. Willamette Basin rivers and streams assessment. DEQ 09-LAB-016. Oregon Department of Environmental Quality, Portland, Oregon.

National Marine Fisheries Service (NMFS). 1997a. Endangered Species Act - Section 7 consultation biological opinion and conference opinion: implementation of land and resource management plans (USFS) and resource management plans (BLM); USDA Forest Service: Rogue River, Siskiyou, Siuslaw, Umpqua, and Winema National Forests; USDI Bureau of Land Management: Coos Bay, Eugene, Medford, Roseburg, and Salem Districts. NMFS, Northwest Region, Seattle, Washington. March 18, 1997

National Marine Fisheries Service (NMFS). 1997b. Endangered Species Act - Section 7 consultation, biological opinion and conference opinion on continued implementation of land and resource management plans (USFS) and land use planning documents (BLM): USDA Forest Service: Klamath, Mendocino, Shasta-Trinity, and Six Rivers National Forests; USDI Bureau of Land Management: Arcata, Clear Lake, and Redding Resource Areas. National Marine Fisheries Service (NMFS), Southwest Region, Long Beach, California. June 20.

National Marine Fisheries Service (NMFS). 2004. Interim endangered and threatened species recovery planning guidance Version 1.3. Silver Spring, Maryland.

National Marine Fisheries Service (NMFS). 2011. Southern Oregon/Northern California Coast recovery domain 5-Year review: summary and evaluation of Southern Oregon/Northern California Coast coho salmon ESU. National Marine Fisheries Service Southwest Region. Long Beach, California. 59 p

NRC (National Research Council). 1992. Restoration of aquatic ecosystems: science, technology, and public policy. National Academy Press, Washington, DC.

— 1996. Upstream: salmon and society in the Pacific Northwest. National Academy Press, Washington, DC.

--- 2004. Endangered and threatened fishes in the Klamath River basin: causes of decline and strategies for recovery. The National Academies Press, Washington, D. C.

Nawa, R.K. and C.A. Frissell. 1993. Measuring scour and fill of gravel streambeds with scour chains and sliding-bead monitors. North American Journal of Fisheries Management. 13:634-639.

Nehlsen. W., J. Williams, and J. Lichatowich. 1991. Pacific salmon at the crossroads: stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16(2): 4–21.

Nickelson, T. 2003. The influence of hatchery coho salmon (Oncorhynchus kisutch) on the productivity of wild coho salmon populations in Oregon coastal basins. Can J Fish Aquat Sci 60:1050–1056

Northwest Forest Plan 1994. U.S. Department of Agriculture Forest Service and U.S.

Department of Interior Bureau of Land Management . Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl; standards and guidelines for management of habitat for late successional and old-growth forest related species within the range of the northern spotted owl. http://www.reo.gov/library/reports/newsandga.pdf

Paulsen, S. G., A. Mayio, D.V. Peck, J.L. Stoddard, E. Tarquinio, S.M. Holdsworth, J. Van Sickle, L.L. Yuan, C.P. Hawkins, A.T. Herlihy, P.R. Kaufmann, M.T. Barbour, D.P. Larsen, and A.R. Olsen. 2008. Condition of stream ecosystems in the US: an overview of the first national assessment. Journal of the North American Benthological Society 27:812–821.

Poff, N. L., J. D. Allan, M. B. Bain, J. R. Karr, K. L. Prestegaard, B. D. Richter, R. E. Sparks, and J. C. Stromberg. 1997. The natural flow regime: a paradigm for river conservation and restoration. BioScience 47:769-784.

Reeves, G.H., J.E. Williams, K.M. Burnett, and K. Gallo. 2006. The aquatic conservation strategy of the Northwest Forest Plan. Conservation Biology 20:319-329.

Roni, P., T. J. Beechie, R. E. Bilby, F. E. Leonetti, M. M. Pollock, and G. R. Pess. 2002. A review of stream restoration techniques and a hierarchical strategy for prioritizing restoration in Pacific Northwest watersheds. North American Journal of Fisheries Management 22:1–20.

Roni, P., K. Hanson, and T. Beechie. 2008. Global review of the physical and biological effectiveness of stream habitat rehabilitation techniques. North American Journal of Fisheries Management 28:856–890.

Ruggerone, G.T., R.M. Peterman, B. Dorner, and K.W. Myers. 2010. Magnitude and trends in abundance of hatchery and wild pink salmon, chum salmon, and sockeye salmon in the North Pacific Ocean. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 2:306-328.

Ruggerone, G.T., B.A. Agler, and J.L. Nielsen. 2012. Evidence for competition at sea between Norton Sound chum salmon and Asian hatchery chum salmon. Environmental Biology of Fishes 94:149-163.

Shields, F.D., C. M. Cooper, Jr., S. S. Knight, and M. T. Moore. 2003. Stream corridor restoration research: a long and winding road. Ecological Engineering 20: 441–454.

Stevens, D.L. Jr. 2002. Sampling design and statistical analysis methods for the integrated biological and physical monitoring of Oregon streams. OPSW-ODFW-2002-07, Department of Statistics, Oregon State University, Corvallis.

Stewart, G. B., H. R. Bayliss, D. A. Showler, W. J. Sutherland, and A. S. Pullin. 2009. Effectiveness of engineered in-stream structure mitigation measures to increase salmonid abundance: a systematic review. Ecological Applications 19: 931–941.

Sudduth, E., J. L. Meyer, and E. S. Bernhardt. 2007. Stream restoration practices in the southeastern United States. Restoration Ecology 15:573–583.

Thompson, D. M. 2006. Did the pre-1980 use of instream structures improve streams? A reanalysis of historical data. Ecological Applications 16:784–796.

U.S. Bureau of Land Management (BLM). 2005. Althouse Creek watershed assessment. U.S. BLM, Medford, OR.165p.

U.S. Bureau of Land Management (BLM). 2003. West Fork Illinois River watershed analysis.

U.S. Bureau of Land Management, Grants Pass Resource area. 181 p.

U.S. Bureau of Land Management (BLM). 1997. Deer Creek watershed analysis. U.S. BLM Medford District, Grants Pass Resource Area. 134 p.

U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM). 2000. East Fork of Illinois River watershed analysis, Version 2.0. USFS and BLM, Medford and Cave Junction, OR.

U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM). (no date). Standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. Attachment A to the record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl.

Williams, T.H., B. Spence, W. Duffy, D. Hillemeier, G. Kautsky, T. Lisle, M. McCain, T. Nickelson, E. Mora, and T. Pearson. 2008. Framework for assessing viability of threatened coho salmon in the Southern Oregon / Northern California Coasts Evolutionarily Significant Unit. NOAA Technical Memorandum NMFS-SWFSC-432.

Williams, T.H., S.T. Lindley, B.C. Spence, D.A. Boughton. 2011a. Draft status review update for salmon and steelhead under the Endangered Species Act: Southwest. NOAATM-NMFS-SWFSC-XXX. December 2010. National Marine Fisheries Service. Southwest Fisheries Science Center. Santa Cruz, CA.

Williams, J.E., and 11 others. 2011b. Native fish conservation areas: a vision for large-scale conservation of native fish communities. Fisheries. 36(6): 267-277.

Woody, C.A., R.M. Hughes, E.J. Wagner, T.P. Quinn, L.H. Roulsen, L.M. Martin, and K. Griswold. 2010. The U.S. General Mining Law of 1872: change is overdue. Fisheries 35:321-331.

Woolsey, S., F. Capelli, T. Gonser, E. Hoehn, M. Hostmann, B. Junker, A. Paetzold, C. Roulier, S. Schweizer, S. Tiegs, K. Tockner, C. Weber, and A. Peter. 2007. A strategy to assess river restoration success. Freshwater Biology 52:752–769.