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Greg Bryant, Charlotte Ambrose, Mark Capelli, Diane Windham and
Assistant Regional Administrator, Protected Species Division
NMFS, Sacramento Area Office
650 Capitol Mall, Suite 8–300
Sacramento, California, 95814–4706

RE: Information for ESA Recovery Planning for Southern Oregon/Northern California Coast, North-Central California Coast, South-Central California Coast and Central Valley Recovery Domains

Dear Ms./Mr. Bryant, Ambrose, Capelli, Windham and Assistant Regional Administrator:

First, please excuse the fact that these comments are a few days past the stated end of the comment period. This is entirely due to the fact that my brain mistakenly stored November 17 as the comment deadline when I read the Federal Register notice some time ago.

Please accept and enter into the record on behalf of the Pacific Rivers Council ("PRC") the comments contained in this letter and in the attached review of the Recovery Strategy for California Coho Salmon, as requested in the Federal Register Notice of September 11, 2006 [Fed. Reg. 71(175): 53421-53422].

PRC is a non-profit conservation organization dedicated to the development and implementation of science-based public policies that protect and restore aquatic ecosystems and the species that depend on them. PRC is incorporated and has its headquarters in the State of Oregon. In 1993, PRC led an environmental coalition to petition for federal protection under the ESA of Pacific coho salmon in Oregon, Washington, Northern California, and Idaho. PRC has over 750 members throughout the United States and Canada. PRC members participate in recreational activities, such as hiking, backpacking, cross-country skiing, nature photography, and river and lake boating throughout the Pacific Northwest, and, where possible, observe and benefit from wild salmon and steelhead.

The attached review employed a conservation/recovery planning and review template developed by PRC science staff (Frissell and Carnefix, in prep) from extensive review of conservation/recovery planning literature and assessments. The intent of this template was use as a tool that would be generally relevant across taxa and conservation/recovery plan types (e.g., recovery plans, Habitat Conservation Plans, etc.). It is intended more to address the overall question of scientifically credible completeness (i.e., "covering all the bases") than exhaustive examination of adequacy of particular plan elements in detail, although it still lends itself reasonably well to assessments of adequacy, and many of our review comments address this. Though intended to be generally applicable, the template was first developed for use assessing recovery/conservation plans for imperiled inland native trout subspecies, and successfully employed by an expert science panel for that purpose. PRC staff and independent scientists have subsequently employed it with minor revision for plans targeting amphibian species and now for several Pacific salmon plans. While specific details of the attached review address elements of the state of California's coho recovery strategy, the topics and issues assessed in the review reflect PRC's evaluation from our experience and the scientific literature of what must be addressed for a conservation/recovery plan to be scientifically credible, with reasonable probability of actually resulting in recovery, which is responsive to NMFS' request for "relevant information from the public that should be addressed during preparation of draft recovery plans."

PRC is a plaintiff in litigation of NMFS' Hatchery Listing Policy, and issues underlying that litigation inform our comments. These are addressed in some detail in the attached review, along with other concerns and thus only briefly generalized and reiterated here. Essentially, PRC asserts that NMFS erred in its interpretation of the Alsea decision (Alsea Valley Alliance v. Evans), as subsequently applied in the Hatchery Listing Policy. The Alsea court essentially ruled that ***if*** NMFS defined an ESU to include hatchery fish, then it had to base listing and recovery decisions on all of the defined ESU, including hatchery fish. It did not, however, compel inclusion of hatchery fish in defined ESUs. PRC asserts that the appropriate approach under both the Alsea decision and ESA's explicit direction to "to provide a program for the conservation of … endangered species and threatened species" and "to **provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved**" is to exclude hatchery fish entirely from listing and status determinations and focus recovery efforts on wild populations and the ecosystems on which they depend. The clear intent of ESA is to recover indigenous populations within their ecosystems, not technology-dependent hatchery populations or hatchery-wild mongrel populations, which must be regarded by default as threats to wild salmon recovery. While ESA does provide for artificial propagation/captive breeding interventions, these are clearly intended as truly last-ditch, last-resort emergency measures against impending extinction, not as widely-employed substitutes for the ecosystem conservation explicitly called for in the Act, nor to mask ongoing declines of wild salmon and habitat, in which past and ongoing hatchery releases are often implicated. Hatchery interventions to supplement extant wild populations that have managed to persist (as ongoing and proposed in the California coho strategy) are especially problematic in this regard, as this creates the situation in which native genetic and life-history diversity and local adaptation are most directly threatened by hatchery

releases.

Finally, we note that multi-species recovery plans as proposed by NMFS for the four California "recovery domains" make sense for species with shared threats, ecosystems/habitat, habitat requirements and recovery needs, as is the case to a significant degree for California salmon and steelhead, as long as individual species do not receive lesser analysis, attention and protection as a result of being combined with others into a multi-species plan. However, several assessments have found the latter problem to be common, i.e., lower scientific adequacy in recovery planning and poorer results for many individual species included in multi-species plans (e.g., Crouse et al. 2002; Hoekstra et al. 2002; Lundquist et al. 2002). We therefore emphasize that

1) adequacy for each listed species covered by the plan;
2) prioritization and focus on protection and restoration of freshwater habitat and connectivity, degradation and fragmentation of which are the primary constraints on salmon/steelhead recovery; and
3) avoiding over-reliance on technological "fixes" such as hatchery interventions, which both threaten wild populations and may mask their continued depressed status and/or further decline

will be essential to credible recovery plans with some reasonable probability of actually leading to recovery of salmon and steelhead populations in California.

Sincerely,

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CA coho state plan (not adopted in any way by NMFS*). Plan is explicitly, totally voluntary, relies on cooperative action. Pilot program exists for the Scott River and Shasta Valley (SSPP) with much more detail than plan in general. The state was waiting to see what NMFS was going to do, NMFS was waiting for the CESA litigation to conclude, so not much progress since plan released in 2004.

This plan looks like reasonable first steps in describing and beginning to implement what it would take to recover coho in CA, but with many major and minor elements still at the "plan to do planning"/"to be developed" stage. Decent job of figuring out what will need to happen, but little evidence of progress beyond that or mechanisms to make it happen.

***Note**: NMFS is currently seeking comment through 11/13/06 on development of four multiple-species recovery plans by recovery "domains" (Southern OR/Northern CA Coast, North-Central CA Coast, South-Central CA Coast, and CA Central Valley) for all CA salmon ESUs and steelhead DPSs. Fed. Reg. 71(175): 53421-53422, 9/11/06.

I. Overarching scientific criteria

The plan reasonably references key source data, theoretical principles, and analyses or analytic methods and justifies use of assumptions based on expert opinion. Primary and other major threats to the species are identified and appropriately and reasonably addressed by planned conservation measures, including mitigation, monitoring and recovery criteria, but no mechanism ensures that planned measures will happen or that regulatory protections which will remain after delisting ("background law", sensu Doremus & Pagel 2002) will be sufficient to ensure against a recurrence of the threats that led to listing. The final rule for federal listing in fact explicitly finds that implementation and effectiveness of existing/ongoing protection efforts were insufficiently certain to preclude listing (Fed. Reg. 70:37190).

Linkage of listing decisions, planning, mitigation and recovery goals/delisting criteria to species ecology (including geographic and genetic population structure) is generally defensible and explicit, but recovery criteria are problematic. General, non-quantitative recovery goals are stated and 1-3 quantitative criteria under each goal are identified, to be individually specified for each of the 23 Recovery Units (RUs) established within the 2 ESUs. However, most of these specific values are "to be determined"* or slated for specification in 2004 or 2005, but we could find no evidence at CDFG website that this has occurred. Crucially, "[t]he recovery goals apply to natural stocks of coho salmon **as well as to coho salmon produced from recovery, conservation, and mitigation hatcheries**" [p. 4.2, emphasis added], which may or may not meet CESA requirements but is problematic under ESA and scientific adequacy requirements. One criterion (percentage of suitable/historic streams with coho detected) is one-size-fits-all generic (60% for downlisting, 75% for delisting, across all RUs); no scientific analysis to support adequacy for recovery of these generic criteria is presented beyond noting that the 60% CCC (Endangered) downlist criterion "corresponds approximately to the current distribution within the SONCC Coho ESU" (Threatened). Further, the plan indicates that the number-of-spawning-adults delisting criterion may not ever be specified for the 17 RUs comprising the Threatened southern Oregon/northern

California coast coho (SONCC) ESU [p. 4.7]. The number-of-spawning-adults downlisting criterion values specified for the only 5 RUs where they are set (range: 1,350 – 15,000) would seem at least "ballpark" reasonable or even conservative relative to those for comparable taxa and standard effective population size considerations ***if*** the entire RU represented a single functional population, but this is acknowledged not to be the case [p. 4.4]. The brood-year-increase criterion appears limited to increase by one brood-year increment, not necessarily to the full complement of 3 (i.e., to 1 where none are present; 1 –> 2; 2 –> 3). No justification of if/how this is adequate for recovery is offered. This does not comport well with the reasonable theoretical discussion of risk-spreading adaptive benefit resulting from life history diversity (including full brood-year complement). Finally, though the PDO cycle is mentioned, minimum length of "sustained trend" required for down/delisting ("at least seven generations, or 21 years") is set to less than half the PDO's approximated period (50 years), without justifying why this would be adequate [pp. 4.2-4.3].

The plan includes reasonable discussions of ecosystem organization and processes, stressing their importance as the necessary context of recovery/restoration measures. It also includes extensive prioritized lists of recommended recovery tasks by prioritized CALWATER subwatersheds (HSAs, Hydrologic Subareas) within larger watersheds (HUs, Hydrologic Units, for which whole-watershed tasks are also specified) within Recovery Units within the two ESUs covered by the plan. Tasks/recommendations vary greatly in number and specificity among RUs, HUs and HSAs, and none reach site-level specificity that we could determine. Many tasks are themselves vague, general, non-specific, e.g., "[c]ontrol erosion to improve migration and summer/over-wintering habitat for coho salmon" [p. 9.81]. Despite generalized ecosystem discussion, there is no linkage of site-specific recovery or restoration measures to a valid ecosystem assessment or evaluation of the likely success of recovery measures in this context.

The plan recommends range-wide evaluation of "the adequacy of riparian buffers and development setbacks where needed for protecting riparian and wetland habitat . . . " and identifies "[s]election of appropriate metrics" as the first component of planning and prioritizing monitoring [p. 5.16], but does not establish metrics of land use pattern and practice and for watershed condition that correspond with maintenance or recovery of habitat condition sufficient for local persistence and regional recovery of the species.

For the SSPP only, this plan addresses surface water use/management issues in greater detail than most, but subsurface water management is not addressed. Needed water acquisition costs are estimated at 20% of recovery costs for the Scott and Shasta valleys and included in total recovery cost estimate ($4.5B, $5B with SSPP water acquisition cost proportion extrapolated to entire recovery area) [p. ES.4]. Such an estimate seems to imply a judgment of sufficiency for recovery but this is not addressed explicitly, reflecting the overall absence of risk assessment/viability analysis to justify this plan and its specific measures. Also:

> To obtain an estimate of the full costs of securing instream flows for coho salmon, this analysis assumes that additional instream flows will be generated solely through the acquisition of water rights from willing sellers. This assumption is made only for the purposes of an illustrative calculation of the cost of recovery

and should not be taken as an endorsement of this approach to increasing instream flows in the SSPP area or elsewhere. [p. 11.5]

The plan does a reasonable job of describing normal resilience and adaptation to natural variation, including extremes, in a context of currently reduced resilience due to degradation/simplification/fragmentation of habitat by human influences (e.g., recognizes potential for cyclic marine productivity to mask reproductive declines of populations, noting that "[t]hese trends must be considered when assessing the success of coho salmon recovery efforts" [p. 3.2]). Yet, as noted, the plan somewhat contradictorily calls for assessing trends for achievement of recovery criteria over less than half the approximated period of the PDO. Population/species robustness to disturbance is recognized as an advantage of natural genetic diversity that the plan purports to conserve. "Land use change trajectories" are identified in a list of "potential ecological and land management variables for coho salmon recovery strategy assessment, monitoring, and research" [Table 5-1, p. 5.18] for a to-be-developed monitoring/adaptive management program. Reasonable forecasts of human development and demographic trends, climatic variability or trends and consideration of possible, low-frequency but high-magnitude natural or human-caused catastrophes are otherwise absent, however; nor are provisions or allowances that increase the plan's robustness to such foreseeable variation, trends, and catastrophes included, beyond the skeleton of the proposed adaptive management/monitoring program.

II. Habitat criteria

ESA critical habitat is not designated or proposed for the two CA coho ESUs covered by this plan (as far as I could tell from FWS' species webpage and Fed. Reg. notices linked from there). Specific variables to describe habitat condition are identified in only generic terms as "potential ecological and land management variables for coho salmon recovery strategy assessment, monitoring, and research" [Table 5-1, p. 5.18], (e.g.,

I. HYDRODYNAMICS AND SEDIMENT TRANSPORT
II. SYSTEM PRODUCTIVITY
A. PRIMARY PRODUCTIVITY
B. INVERTEBRATE
C. FISH
D. NUTRIENT CYCLING
III. FLUVIAL GEOMORPHOLOGY
A. SEDIMENT (embeddedness, suspended)
B. TURBIDITY
C. SUBSTRATE PARTICLE SIZE
D. LWD CYCLING
E. LAND SLIDING AND DEBRIS FLOW
IV. HYDROLOGY
A. FLOW (rate, timing, quantity)
B. TEMPERATURE
C. OTHER WATER QUALITY (i.e., DO) **. . .).**

No threshold criteria or conditions are specified for 1) suitable or 2) high-quality habitat, nor are methods identified for measurement and monitoring of habitat conditions relative to any such biological thresholds. General discussion of species ecology provides reasonable justification for the potential variables generically listed, though obviously not

for their methods of measurement, since these are not yet specified. There is no provision in the plan for testing of any assumptions that "improvement" in monitored habitat variables equates to improvement in species status, though it might be implied that proposed direct monitoring of populations negates any need for such testing. Given its explicitly voluntary nature and explicit disclaimer of establishing any regulatory force or framework, the plan does not establish reserves or protected areas in any meaningful sense. Recovery criteria specifying conservation or reintroduction leading to eventual occupancy of 75% "of suitable/historic streams" seem reasonably defensible, however, if plan measures are actually implemented and adequate to achieve this level of recovery. Because no true reserves are established by the plan – i.e., with protection and restoration of the target species the determining factor in their management – there is no way to determine whether proposed recovery measures will produce a network of habitat that includes patches of sufficiently large size, relatively unfragmented and protected in terms of maintaining natural biophysical processes internally (e.g., whole watersheds versus fragments of watersheds) with potential for dispersal and connectivity between them adequate to support local populations of the species. Rather, the plan seems based on hopeful assumptions that recommended measures will occur through cooperative efforts under existing regulatory frameworks and standards, and will be adequate for recovery without establishment of any network of true reserves.

III. Artificial culture and release practices

The plan credibly assesses the history and reasons for success and failure of past artificial culture and translocation practices related to this species, including appropriate and explicit recognition of hatchery interventions as a possible factor in past declines and as a potential ongoing threat to recovery, but concludes that

> . . . their potential to do harm is ***limited*** by decreased hatchery production and modern management policy. . . . Hatcheries in California have dramatically reduced their production of coho salmon, limited outplanting, and stopped virtually all stock transfers in recent years. Therefore, current impacts of hatchery fish on remaining natural stocks are ***significantly less than in the past***. [p. 3.5, emphasis added]

There is no scientific justification, however, that reduction of impacts to "significantly less than in the past" will be sufficient for coho recovery, especially given that hatchery interventions are proposed as a potential recovery tool, and that ***recovery criteria explicitly make no distinction between hatchery-origin coho and wild populations.*** The plan includes "Appendix G: Role of Existing Hatcheries" by the Hatchery Working Group of the CRT, with the interesting note that

> [t]he following report contains elements agreed upon at that [June 12, 2003] meeting **and subsequent additions by Working Group members. Not all Working Group members supported the addition of the following subsections entitled "Principles of hatchery operation in support of coho salmon recovery," "Monitoring and Evaluation Recommendations," and**

> **"Specific Recommendations"** in this section of the Recovery Strategy. However, these subsections are included in this draft to reflect the contributions of all Working Group members and decisions made at the meeting. [p. G.1, emphasis added]

This apparent internal dispute is worrisome, given that the disputed sections contain elements absolutely essential to any credible claim for a scientifically justifiable role for hatcheries in California coho recovery. "Appendix H: Recommended Guidelines for Recovery Hatcheries", if rigorously adhered to, contains precautionary measures that should reduce the likelihood of hatchery interventions impeding coho recovery (largely by minimizing/constraining their use), including essential recognition that such interventions in the name of recovery are experimental and unproven[1], and so should be reserved for "extreme", "last-chance" cases (although scientific justification is not provided for the claim that the associated risks are acceptable in such cases):

> . . . extremely depleted stocks and ESA and CESA listings of many California salmon populations have made it necessary for the Department to evaluate the use of specialized anadromous fish hatchery programs along with extensive monitoring to help meet certain recovery goals. In some of these extreme cases the risks posed by releasing relatively small numbers of hatchery fish from well defined programs focused on recovery are acceptable. Still, the Department considers captive broodstock and recovery supplementation projects to be unproven last-chance efforts to protect and recover severely reduced and imperiled populations. The small number of projects that exist have not shown conclusively that they are able to rehabilitate depleted runs or establish recolonized runs. The evidence of whether hatchery fish can reliably establish natural runs is mixed and the results of hatchery introductions are unpredictable (see review in CDFG 2002). Therefore, **it is prudent that recovery hatcheries only be employed when all other means of coho salmon recovery have been exhausted or when extirpation is imminent. The Department does**

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[1] In fact, even this caveat may be insufficient, i.e., overly optimistic. See, e.g.,

Oosterhout, G.R., C.W. Huntington, T.E. Nickelson and P.W. Lawson. 2005. Potential benefits of a conservation hatchery program for supplementing Oregon coast coho salmon *(Oncorhynchus kisutch)* populations: a stochastic model investigation. Can. J. Fish Aquat. Sci. 62:1920-1935.

" . . . perhaps the most important observation to be derived from this study is that hatcheries do not produce fish that are identical to wild fish, even in a program designed to minimize the differences between the two production types." Knudsen, Curtis.M., Steve L. Schroder, Mark V. Johnston, Todd N. Pearsons, William J. Bosch and David E. Fast. 2006. Comparison of life history traits between first-generation hatchery and wild upper Yakima River spring Chinook salmon. Transactions of the American Fisheries Society 135:1130–1144.

Kostow, Kathryn E., and Shijie Zhou. 2006. The Effect of an Introduced Summer Steelhead Hatchery Stock on the Productivity of a Wild Winter Steelhead Population Transactions of the American Fisheries Society 135:825–841.

Araki, Hitoshi, William R. Ardren, Erik Olsen, Becky Cooper, and Michael S. Blouin. 2006. Reproductive Success of Captive-Bred Steelhead Trout in the Wild: Evaluation of Three Hatchery Programs in the Hood River. Conservation Biology (early online publication).

> **not consider recovery hatchery programs a substitute for habitat improvement and improvement of natural salmon production.** [p. H.1, emphasis]

Guidelines address the possible consequences of artificial culture and translocation practices on genetic diversity, local adaptation and fitness (including hatchery/wild interactions and impacts of non-conservation stocking of target or other taxa, e.g., for sport/commercial harvest) and are intended to minimize them, but it is not clear they are adequate for this or, if so, that they will be consistently and rigorously applied to accomplish this or to ensure that cultured or translocated stocks constitute a representative slice of the extant genetic diversity and heritage of the species. It is not clear that guidelines ensure that donor populations for artificial culture or translocation activities are not placed at risk by the taking of individuals for these interventions. The only guideline apparently addressing this states, "If target population is very small, consider taking all available representatives of the population into the hatchery. But, only if the risk to the population by bringing it into the hatchery is less than that in the stream with habitat restoration." General guidelines call for minimizing the potential for artificial culture and release practices to provide a vector of pathogens to populations in the wild (target or non-target species) and ensure that this risk is acceptable, but are not specific as to how this is to be accomplished.

The somewhat equivocal to self-contradictory nature of these considerations of hatchery interventions in the name of coho recovery, along with previously noted signs of internal disagreement, (as well as the existence of an established hatchery infrastructure and constituency) raise concerns regarding whether the stated and essential constraints and guidelines will in fact be rigorously adhered to, as is necessary to preclude hatchery interventions from impeding recovery. Diversion of resources from proven recovery measures that directly address causes of declines (e.g., habitat fragmentation/degradation) to unproven and potentially harmful hatchery interventions is a related concern. Given well-documented risks and highly speculative, unproven benefits for recovery from hatchery interventions, supplementation/"reintroduction" where extant wild coho populations persist or may persist is at best highly questionable in terms of scientific justification. These concerns are strengthened by the fact that two coho "recovery hatchery programs" are already in operation, despite stringent stated pre-conditions for their establishment (raising the question of how closely guidelines are actually being followed), including

> 4. In all cases, **recovery hatchery operations should be subsequent to or concomitant with active and focused habitat improvements** designed to increase natural production with the ultimate objective of reaching recovery goals. . . .
>
> 8. . . . **A comprehensive risk/benefit analysis will be prepared prior to the establishment of any new recovery hatchery operation**. . . .
>
> 10. Recovery hatchery operations should be done in a way that protects all existing populations of native salmonids and other native fish already living in the

receiving ecosystem. **An assessment (e.g., identification of species composition, size, and density measurement) should be done to determine if there will be impacts (e.g., competition, predation, niche partitioning) to fish already present.**

11. Hatchery releases should be based on the receiving ecosystem's carrying capacity. **Conservation/recovery hatchery programs should only be approved in places where guideline conditions are met and habitat is not a limiting factor for the existing natural stock, where unused habitat is demonstrably available, and where competition and other negative ecological interactions between natural- and proposed hatchery-origin stock can be avoided or are minimal. Habitat availability includes demonstrably consistent connectivity of spawning habitat, rearing habitat, and corridors for migration under current conditions. . . .**

16. **Recovery hatchery programs should have detailed operating plans, including emergency and decommission plans prior to the beginning of operations. Plans should carefully define the intended geographic scope of the project (e.g., run, watershed, region, ESU).**

IV. Species interactions and nontarget species concerns

"Recovery hatchery" guidelines call for assessment of possible effects on non-target species and ensuring that adverse effects are avoided, mitigated, or of minimal biological or cultural significance (e.g., see "10" above), but these issues are not addressed for other elements of the plan. Present and future risks posed by co-occurring non-native or invasive species (including pathogens), time-trends in invasive species, security of existing habitat free of non-native species (where they are a threat) and ensuring that future invasions will not occur are likewise unaddressed. Habitat, harvest, or other management interventions are not evaluated for possible unintended benefits to non-native or invasive species, and designed to minimize the possibility of adverse side effects. Except in general discussion of habitat requirements, where certain habitat elements (e.g., riparian vegetation, LWD, substrate) are mentioned as habitat for coho prey, and in general habitat carrying capacity guideline for hatchery releases (see "11" above), the plan does not identify the prey base of the species or address the question of ensuring that food resources are adequate to support recovery. The plan does identify several natural or introduced predators on the species and addresses their ecological relationship with the target species in general terms, but there is no mechanism or linkage to recovery or restoration measures to ensure that they are not countervailed by predation.

V. Harvest management (targeted and incidental)

The plan briefly accounts for the biological impact of present day levels of human harvest, legal, illegal, and incidental, but historical harvest is surprisingly overlooked except as an indicator of declines (i.e., its impact or role in declines is not addressed in any detail). Harvest restrictions are in place and described, and permitted or incidental

harvest seems reasonably justified in terms of the ability of the populations to sustain this mortality source (currently no commercial fishery). Restoration beyond ESA-required recovery to levels permitting commercial fishery is an explicit goal of the plan.

VI. Demographic and genetic data

Status and trend data are typically unavailable for many populations, including many provisionally identified as "key populations". A fairly typical HU status description where some status information is reported: "There are few definitive data on historical coho salmon abundance in this HU. Most broodyear lineages appear to be extirpated or very weak in all three watersheds, although surveys found coho salmon in the Año Nuevo HSA in 2002." [p. 6.46] Discussion of biology and requirements of life stages is reasonably thorough and accurate, but information is lacking on mortality magnitudes for different life stages. Conservation measures generally at least reference needs of life stages at which they are targeted. Life history and behavioral diversity within key life stages and populations is addressed, and the plan seeks to ensure that existing or critical natural life history and behavioral diversity are maintained or restored, and not compromised. However, where 1 - 3 brood years are extirpated, the plan appears to settle for reestablishment of one more brood year than currently exists, not necessarily the full complement of three, while providing no scientific justification that this is adequate for recovery.

There is no analysis of short- and long-term extinction risk for individual populations linked to the conservation rules, but an extinction risk rating mapped at the watershed (HSA) scale "combines risk (human density, water diversions, road density) and population parameters (consistent presence of coho salmon, isolation index for coho salmon populations, and run length of coho salmon populations)." [p. 6.55] Both high-risk and "refugia" (i.e., "key") populations are proposed for top priority of funding and recovery efforts. The plan states, "For California coho salmon, evaluation of viability is based on assessments of abundance, population growth rate, population structure, and diversity, for which reliable estimates are not available. Therefore, it is not possible to determine viability targets, in terms of numbers of fish, for coho salmon at this time." [p. 2.11] Projected resilience/viability can and should be modeled by using 'best guess' numbers tested against different environmental scenarios, which can produce reasonably useful numbers without having detailed quantitative information for individual populations. In fact, the plan notes that NMFS' TRTs are assessing viability, and proposes to revise recovery criteria upon completion of these estimates. There is no meaningful cumulative effects analysis as part of a risk assessment. Risks and status of hybridization and introgression are analyzed only in the context of hatchery guidelines to justify the conservation rules, but it is not clear that guidelines will minimize these risks sufficiently to avoid impeding recovery.

VII. Critical uncertainties

Critical uncertainties and assumptions are reasonably clearly identified, but not clearly accommodated in the plan, e.g. through conservative assumptions that are biologically robust to error, or through factors of safety. The plan is driven by assumptions of what

people will do voluntarily more than what is required for recovery. Consultation required under ESA provides the only mechanism that may ensure that biological mitigation is consummated prior to the adverse impact of any permitted take or incidental mortality. The potential consequences of this are acknowledged, but it is not clear that they have been specifically and fully accounted for. The plan acknowledges the necessity of a monitoring or research loop designed to 1) ascertain that the plan deals adequately with uncertain issues in a way that promotes recovery; and 2) close the knowledge gaps through adaptive management, and a skeletal framework for such a program is sketched out, but details – mechanisms, methods, responsible parties, adaptive management triggers, etc. – are absent, to-be-developed.

VIII. Implementation and adaptive management issues

The plan is explicitly voluntary, not holding parties with authority or responsibility for particular actions to any firm, legal commitment for implementation, which is explicitly disclaimed along with any regulatory force beyond that under existing law (e.g., take prohibition, consultation requirements under ESA; Clean Water Act; etc.). The plan makes no provision for commitment of fiscal and personnel resources to ensure recovery measures are funded and staffed beyond designation of one range-wide and two regional coordinators within CDFG. The Fisheries Restoration Grants Program (FRGP), identified as a primary funding mechanism, is applicant proposal-driven, not based on ecological priorities, although reasonable evaluation criteria are given for prioritizing projects once application is made. A long list describes grant programs, etc. as potential funding mechanisms, but no commitments. There is heavy emphasis on "minimizing social and economic impacts", voluntary incentives, private property rights, etc. Identified/recommended recovery measures list potential lead and other "action entities", but without commitment or clear delineation of responsibilities of cooperators. There is only a skeletal plan to develop an explicit monitoring program to ensure the implementation of the recovery plan, with generic listing of potential elements to be monitored. Target dates specified in the plan for establishing recovery criteria have passed without being met, strongly suggesting that no adequate program is yet in place. There is a similarly skeletal proposal for monitoring the biological effectiveness of key recovery and restoration measures (e.g., "1. Selection of appropriate metrics; 2. Determination of minimum data sets required to describe baseline conditions; . . ."). Sufficient monitoring to evaluate the overall population trend and recovery of the species is not yet specified, though there are proposals to evaluate and/or incorporate some existing and ongoing monitoring programs. Thus, there is not yet any decision analysis system to track population or key habitat trends and to trigger plan revision or other emergency actions for mid-plan course correction, nor is there provision for an emergency management response to natural or large-scale human-caused catastrophe that changes the assumptions on which the plan is based. Feasibility and cost/benefit assessments attempt to qualitatively account for benefits as well as costs of recovery and recovery measures, including difficult-to-quantify/monetize values such as ecosystem services (e.g., clean water sources, biodiversity conservation, nutrient cycling, recreational, cultural and aesthetic resources, etc.) – though it is unclear how adequate or rigorous the benefit assessment is – concluding:

> Although coho salmon recovery will have significant costs, it will also provide economic benefits. While this report does not quantify the economic benefits, they will very likely exceed the cost of recovery. . . . [ES.4, numerous examples and mechanisms listed]
>
> Coho salmon recovery can also result in benefits associated with non-use values. These values include intrinsic values, which are based simply on the knowledge of the resource's existence, and bequest values which confer value to the resource for the benefit of future generations. For California coho salmon recovery, these could be significantly higher than the fiscal costs of recovery. [ES.5]

Additional Literature cited

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