Independent Peer Review by the
Center for Independent Experts (CIE)

Assessment of the Draft Recovery Plan for California's South-Central California Steelhead Distinct Population Segment

by

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1 EXECUTIVE SUMMARY

1.1 IMPETUS AND GOALS FOR THE REVIEW

The purpose of this independent review is to evaluate and comment on the Draft Recovery Plan for the South-Central California Steelhead Distinct Population Segment (DPS). The scope of work focused on the principal elements required in a recovery plan as defined by the federal Endangered Species Act (ESA) and by the National Marine Fisheries Service (NMFS) Interim Recovery Planning Guidance. The primary role of the review is to conduct an impartial peer review in accordance with the Terms of Reference (Appendix B) to ensure that the best available science has been utilized for the forthcoming National Marine Fisheries Service (NMFS) management decisions that will be made that pertain to the recovery of South-Central California Steelhead DPS.

1.2 MAIN CONCLUSIONS AND RECOMMENDATIONS

The main conclusions and recommendations are provided here in summary form only. Please note that additional explanations for these conclusions and recommendations, where necessary, are provided in Section 6 of this report entitled "Conclusions and Recommendations".

1. In general, the Draft Recovery Plan includes and cites the best scientific and commercial information available on *Oncorhynchus mykiss* and on the South-Central California Steelhead DPS and its habitats, including threats to the species, its habitat, and large-scale perturbations such as climate change and ocean conditions.

2. The Draft Recovery Plan identifies, and discusses the potential consequences of, uncertainties associated with the recommendations made by the Plan. Studies and theories that might be viewed to be in opposition to the Plan's findings and recommendations have been acknowledged and discussed.

3. For the most part, I would judge most of the scientific conclusions to be sound and to have been derived logically from the results, although the recovery targets for annual run size and percent anadromy merit re-examination.

4. With two possible exceptions (those pertaining to recovery timelines and recovery costs), the Draft Recovery Plan meets the requirements of a recovery plan as defined in section 4(f)(1) of the ESA, and sections 1.1 and 1.2 of the NMFS Interim Recovery Planning Guidance (NMFS 2006).

5. The Draft Recovery Plan provides a clear presentation of the extinction risk faced by the South-Central California Steelhead DPS, the threats faced by the DPS, and the necessary actions to remove or reduce the threats such that the recovery objectives can be achieved.

6. For the next 1-2 decades, the recovery strategy and overall recovery plan provide clear guidance to all those involved in recovery activities to promulgate the recovery of the South-Central California Steelhead DPS.

7. It is recommended that additional analysis be undertaken to estimate the mean annual run size that would provide for a 95% chance of population persistence over a period of 100 years.

8. It is recommended that Recovery Criterion P.2 on Ocean Conditions be re-evaluated and possibly deleted.

9. It is recommended that the potential utility of habitat-based conservation targets for run size be considered.

10. It is recommended that Recovery Criterion P.4 Anadromous Fraction be revised.

11. It is recommended that the identification of natural waterfalls as a significant threat, and the sanctioned removal of natural waterfalls as a Recovery Action, be reconsidered.

1.3 INTERPRETATION OF THE FINDINGS WITH RESPECT TO CONCLUSIONS AND MANAGEMENT ADVICE

The Draft Recovery Plan provides a description and summary analysis of the threats facing the South-Central California Steelhead DPS. The Plan notes, in fact, that all factors leading to the federal listing are still persistent and that there have been few changes to the factors affecting the DPS since the time of listing. The Draft Recovery Plan identifies a series of monitoring and research initiatives to address the numerous knowledge gaps in the current state of knowledge of steelhead biology, to reduce the uncertainties associated with the recovery initiatives, and to track temporal changes in the status of the South-Central California Steelhead DPS. The monitoring programs will provide a sound empirical basis for adaptive management, manifested primarily by revisions to the recovery initiatives as their relative effectiveness in recovering the DPS become better known. The Draft Recovery Plan has delineated those aspects of the biology, life history and threats pertinent to the endangerment and recovery of the South-Central California Steelhead DPS. The recovery plan appropriately considers all elements of the biology and life history of steelhead in assessing the threats faced by the DPS. For the most part, the conservation measures proposed within each of the four Biogeographic Population Groups in the DPS are appropriate and should prove effective in recovering the species.

2 INTRODUCTION

2.1 BACKGROUND

There are 10 Evolutionarily Significant Units/Distinct Population Segments (ESUs/DPSs) of salmon and steelhead in California listed as federally endangered or threatened under the ESA. They are organized into four geographic recovery domains. It is my understanding that each recovery domain contains: (1) one or more salmon and steelhead ESU/DPS; (2) a Science Center led Technical Recovery Team (TRT) responsible for developing historical population structure and population viability goals for the recovery plan, and identifying research and monitoring needs; and (3) a recovery coordinator responsible for facilitating the development of a recovery plan for the domain.

The South-Central California Steelhead DPS, first listed as a Threatened species under the ESA in 1997, includes populations of *Oncorhynchus mykiss* inhabiting watersheds from the Pajaro River in Monterey County south to Arroyo Grande Creek in San Luis Obispo County. The area includes those portions of the coastal watersheds that are at least seasonally accessible to steelhead entering from the ocean or that would be accessible in the absence of anthropogenic barriers to fish passage. Investigation of the genetic structure of juvenile *O. mykiss* collected from freshwater habitats, including instream areas upstream of migration barriers within the populations considered to be of greatest importance to the DPS (Core 1 populations), confirm that the present-day populations are dominated by ancestry of indigenous south-central coastal steelhead. The geographic area of the DPS contains a series of large river basins that extend inland considerable distances and short coastal systems, some within urbanized areas. The Draft Recovery Plan serves as a guideline for achieving recovery goals by describing the watersheds and recovery actions that must be taken to improve the status of the species and its habitat.

The NMFS Recovery Plan for the south-central California steelhead is expected to generate substantial interest from outside parties because it: (1) will contain recommendations involving water supplies for a variety of municipalities and agricultural users in an area of low annual rainfall; (2) will prioritize watersheds for targeted restoration actions; (3) could influence local and regional planning efforts and decisions involving land-development patterns; and (4) advises state agencies and local governments on actions necessary to further improve land-use and water-management practices to protect the listed species and its freshwater habitats. The Draft Recovery Plan will include a large geographic area in southern California and has the potential for wide-ranging implications in the public and private sectors. Stakeholder interest will be high due to the potential impact to millions of south-central Californians and is expected to lead to inquiries from elected representatives at the local, state and Federal levels.

2.2 TERMS OF REFERENCE

The Terms of Reference specified that the scope of work should focus on the principal elements required in a recovery plan, as defined by section 4(f)(1) of the federal Endangered Species Act and sections 1.1 and 1.2 of the National Marine Fisheries Service Interim Recovery Planning Guidance (NMFS 2006). These principal elements were articulated as follows:

Section 4(f)(1)(b) of ESA states that “each plan must include, to the maximum extent practicable:

- a description of such site-specific management actions as may be necessary to achieve the plan’s goal for the conservation and survival of the species;
- objective, measurable criteria which, when met, would result in a determination…that the species be removed from the list; and,
- estimates of the time required and the cost to carry out those measures needed to achieve the plan’s goal and to achieve intermediate steps toward that goal.”

From section 1.1 of NMFS (2006), a recovery plan should:

- “Delineate those aspects of the species’ biology, life history, and threats that are pertinent to its endangerment and recovery;
- Outline and justify a strategy to achieve recovery;
- Identify the actions necessary to achieve recovery of the species; and
- Identify goals and criteria by which to measure the species’ achievement of recovery.”

The Terms of Reference also specified a series of questions to be addressed by the CIE Peer Reviewers when evaluating (i) the adequacy, appropriateness and application of data used in the Plan and (ii) the recommendations made in the Plan (see Annex 1, Appendix B).

2.3 DESCRIPTION OF REVIEW ACTIVITIES

I received the Draft Recovery Plan at end of day on Wednesday, 15 July 2009, from Penny Ruvelas, Regional Section 7 Coordinator, National Marine Fisheries Service, Protected Resources Division. I received a CD containing background documents on Monday, 20 July 2009. I began my review on 20 July 2009 and completed it on 31 July 2009. The report was submitted to the Center for Independent Experts (CIE) on Friday, 31 July 2009, in accordance with the deadline stipulated in the Statement of Work (Appendix B of the present document).

3 REVIEW OF INFORMATION USED IN THE RECOVERY PLAN

Steelhead Biology and Ecology: The Draft Recovery Plan has delineated those aspects of the biology, life history and threats pertinent to the endangerment and recovery of steelhead (*Oncorhynchus mykiss*) in south-central California.

Anadromy is, of course, a key element, being the primary means of distinguishing the migratory steelhead from the resident rainbow trout. Steelhead are anadromous fish, meaning that they breed and spend their early life (1-3 years) in fresh water before undertaking a feeding migration to the ocean and returning after 2-3 years to fresh water to spawn. For *O. mykiss*, the term 'steelhead' identifies fish that undergo anadromy, whereas 'rainbow trout' identifies *O. mykiss* that undergo their entire life cycle in fresh water. All *O. mykiss* are capable of spawning more than once in their lives (iteroparity). These salmonids, thus, exhibit complex life cycles, and the Draft Recovery Plan appropriately considers all elements of the biology and life history associated with this complexity in assessing the threats faced by the ESU, although the plan does acknowledge that lack of empirical demographic information on resident *O. mykiss* (indeed on most of the populations of steelhead) is a deficiency that needs to be rectified.

In addition to the resident and migratory forms of *O. mykiss*, the Draft Recovery Plan also identifies the existence of the very interesting “lagoon-anadromous” form. This form comprises individuals that emigrate from the river into lagoons as juveniles, grow extremely well in these lagoons, and thus enter the ocean earlier than most migrants (which will have a positive effect on their realised per capita rate of increase) and apparently at a greater size than most migrants (something that should positively influence survival at sea).

Based on a survey conducted in 2002, of the 36 watersheds in which steelhead were known to have occurred historically, 86-94% were still occupied either by resident fish or by steelhead. In addition, 3 of 18 watersheds that had no previous historical record of steelhead were found to contain steelhead in 2002. Helmbrecht and Boughton (2005) provide summary details of survey efforts on South-Central California Steelhead populations. There is evidence that the range of South-Central California Steelhead has contracted northward in recent decades (Boughton et al. 2005), primarily as a result of the construction of dams, flood-control structures and other barriers to fish passage, and secondarily in association with warming temperatures, possibly a consequence of climate change. Of the approximately 77 rivers in which steelhead below man-made barriers had been extirpated, Boughton et al. (2005) reported that resident *O. mykiss* continued to persist above barriers in these same systems.

Based on a suite of geological, climatic, and hydrographic characteristics, in conjunction with information on the historic populations of the South-Central California Steelhead DPS (e.g., Boughton et al. 2005; Boughton and Goslin 2006; Boughton et al. 2006), the TRT partitioned the DPS into four Biogeographic Population Groups (BPGs): Interior Coast Range; Carmel Basin; Big Sur Coast; and San Luis Obispo Terrace. Each BPG is considered to be comprised of multiple watersheds, and each watershed has been assumed to house a single population of steelhead. The TRT has identified scenarios for the ways in which these populations might 'interact' from a genetic or interbreeding perspective, drawing upon several plausible models of migration and dispersal among populations.

There are very few data available that would allow one to estimate temporal trends in abundance of steelhead within the DPS. Nonetheless, based on the best available information, the TRT has concluded that annual runs totaled approximately 27,000 historically to 4,740 adults in the five most productive watersheds in 1965, to fewer than 500 adults in these same watersheds in 1996. The South-Central California Steelhead DPS was listed as a Threatened species under the ESA in 1997 and in 2006.

Mitochondrial DNA and microsatellite DNA analyses have documented genetic differentiation among steelhead populations within the DPS. Additional conclusions of note are that: (i) there has not been widespread introgression of hatchery trout in naturally breeding populations (Girman and Garza 2006; Garza and Clemento 2007) and that (ii) a great deal of the genetic variability in *O. mykiss* exists within, rather than among, populations (*O. mykiss* above and below dams within the same river are closely related to one another) (Girman and Garza 2006). Investigation of the genetic structure of juvenile *O. mykiss* collected from freshwater habitats, including areas upstream of migration barriers within the populations considered to be of greatest importance to the DPS (Core 1 populations), confirm that the present-day populations are dominated by ancestry of indigenous south-central coastal steelhead (Clemento et al. 2009). A study of *O. mykiss* in the Santa Ynez River reported low effective population sizes consistent with low census sizes, temporal stability in genetic variability, and little genetic presence of hatchery strains (Garza and Clemento 2007).

A central question remains as to whether resident and migratory *O. mykiss* are, generally or rarely, members of the same breeding population.

Factors Leading to Federal Listing: The Draft Recovery Plan provides a description and summary analysis of the threats facing the South-Central California Steelhead DPS. Details are provided in terms of each of the five listing factors. These are discussed in terms of the magnitude of the threats at the time of listing and within the context of how, and whether, these threats have changed since listing. The Plan notes, in fact, that all factors leading to the federal listing are still persistent and that there have been few changes to the factors affecting the DPS since the time of listing.

Among the listing factors, those deemed to have contributed the most to the decline of South-Central California Steelhead are the destruction and modification of habitat and the existence of man-made barriers that have impeded, or prevented, access by steelhead to their historically accessible spawning grounds and/or juvenile-rearing habitat. Curiously, recreational angling is still permitted for *O. mykiss*, despite the incremental, non-natural mortality that this must impose on the threatened DPS. Additional factors thought to be threatening the persistence of this steelhead DPS include environmental variability and stocking programs, most notably of hatchery-derived resident *O. mykiss* by the California Department of Fish and Game.

Threats Assessment: The Nature Conservancy's Conservation Action Planning (CAP) methodology was used to assess current and expected threats to the persistence and recovery of the South-Central California Steelhead DPS (Appendix D of the Draft Recovery Plan). There is considerable precedence for using the CAP methodology. The Plan also notes that the best available information, including information not readily captured by the CAP methodology (such as climate change and changes to the marine environment), was included in the threats assessment process.

The following threat sources were identified as affecting more than 50% of the watersheds in at least one of the 4 BPGs: dams and surface water diversions; groundwater extraction; levees and channelization; recreational facilities; urban development; other passage barriers; and agricultural development.

Recovery Goals, Objectives and Criteria: The recovery plan provided details on recovery strategies developed at the DPS-wide level and at the Biogeographic Population Group (BPG) level. Specifically, to recover the South-Central California Steelhead, the following over-arching recovery objectives have been identified in the Draft Recovery Plan:

1. Prevent steelhead extinction by protecting existing populations and their habitats;

2. Maintain current distribution of steelhead and restore distribution to previously occupied areas that are essential to recovery;

3. Increase abundance of steelhead to viable populations levels, including the expression of all life history forms and strategies;

4. Conserve existing genetic diversity and provide opportunities for interchange of genetic material between and within viable populations;

5. Maintain and restore suitable habitat conditions and characteristics for all life history stages so that viable populations can be sustained;

6. Conduct research and monitoring necessary to refine and demonstrate attainment of recovery criteria.

DPS-Wide Recovery Actions: At the DPS-wide level, the recovery actions are designed to address common threats across the range of the DPS, such as (i) human-constructed physical barriers to fish migration, (ii) inappropriate water storage and release practices, (iii) inadequate implementation and enforcement of local, state and federal regulations, and (iv) a variety of inappropriate land-use practices. Twenty-one DPS-wide recovery actions have been articulated by the TRT.

The Draft Recovery Plan notes that the effective implementation of the recovery actions will require: (i) development of new and effective implementation of current laws, policies, and regulations; (ii) adequate funding; (iii) strategic partnerships; (iv) appropriate prioritization of activities related to research, threat abatement and monitoring; and (v) effective outreach and comprehensive education.

Threat Sources at the BPG Level: Four chapters of the Draft Recovery Plan (8 through 11) deal specifically with recovery actions at the Biogeographic Population Group (BPG) level. These chapters provide excellent descriptions of the 4 BPGs, the levels of population density experienced by each, current land-use and watershed conditions, and colour-based summaries of the results of the CAP Workbook exercises (see Appendix D of the Draft Recovery Plan). The key sources of stress for each BPG are:

Interior Coast Range BPG *(many threats are ranked* ***high to very high*** *in severity, particularly with respect to the three sources of stress listed below)*

- dams and surface water diversion
- groundwater extraction
- agricultural development

Carmel River BPG *(all threats are ranked* ***high to very high*** *in severity)*

- dams and surface water diversion
- groundwater extraction
- urban development
- levees and channelization

Big Sur BPG *(most threats are ranked* ***medium to low*** *in severity)*

- dams, surface water diversions, and other passage barriers
- pollution
- groundwater extraction

San Luis Obispo BPG *(with the exception of the four northernmost rivers, many threats are ranked* ***medium to very high*** *in severity, particularly the four identified here)*

- dams and surface water diversions
- agricultural development
- groundwater extraction
- levees and channelization

Monitoring, Research and Adaptive Management: The Draft Recovery Plan identifies a series of monitoring and research initiatives to address the numerous knowledge gaps in the current state of knowledge of steelhead biology, to reduce the uncertainties associated with the recovery initiatives, and to track temporal changes in the status of the South-Central California Steelhead DPS. The monitoring programs will provide an empirical basis for adaptive management, manifested primarily by revisions to the recovery initiatives as their relative effectiveness in recovering the DPS becomes better known.

Implementation of the Recovery Plan: The Draft Recovery Plan ends with a description of how the proposed recovery initiatives can be integrated into the daily tasks and decision-making by NMFS. In particular, the Plan draws attention to the intention of NMFS: to work constructively with constituents; to conduct an aggressive outreach and education program; to facilitate a consistent framework for research, monitoring and adaptive management; and to implement an appropriate tracking system to allow the agency to meet various statutory obligations. Various regulatory tools available to NMFS to protect and recover the South-Central California Steelhead DPS under the ESA are detailed with reference to the appropriate section(s) within the Act.

4 REVIEW AND EVALUATION OF THE FINDINGS MADE IN THE RECOVERY PLAN

4.1 DPS CONSIDERATIONS: POPULATIONS, HABITATS AND THREATS

The Draft Recovery Plan has delineated those aspects of the biology, life history and threats pertinent to the endangerment and recovery of the South-Central California Steelhead DPS. For the most part, I find no substantive fault with the conservation measures being proposed within each of the BPGs, although below I do comment on a few of the suggestions and assertions that have been articulated in Chapters 8 through 11.

(a) Removal of Natural Barriers -- Waterfalls: Among the Threat Sources identified in Table 7-1 (page 76), one stands out: natural barriers. The recovery action associated with this 'threat' includes the removal of natural fish passage barriers which, as the narrative of the Draft Recovery Plan later makes clear, means natural waterfalls. This physically intrusive recovery action could be interpreted as being inconsistent with the second of the six over-arching Recovery Objectives, i.e., "to maintain current distribution of steelhead and restore distribution to previously occupied areas that are essential to recovery". That is, the Recovery Objectives do not identify expansion of steelhead into previously unoccupied habitat as being of primary import.

Another point to consider is the degree to which the removal of natural waterfalls is likely to increase the extinction probability of rainbow trout that presumably inhabit the waters above these natural waterfalls. Activities that threaten resident *O. mykiss* may be interpreted as being inconsistent with Recovery Objective 5 to "maintain and restore suitable habitat conditions and characteristics *for all life history stages* so that viable populations can be sustained " [*italics* added]. The Big Sur Coast BPG apparently contains "some of the least altered watersheds within any of the four BPG regions in the SCCS Recovery Planning Area". Why, then, alter it further by removing naturally occurring waterfalls? More importantly, perhaps, is the "mixed message" it will almost inevitably send to those who will disagree with some of the other recovery actions being proposed.

Thus, I do not agree with the assertion that the large, naturally occurring waterfall in the Salmon Creek watershed constitutes a "significant threat to the persistence of anadromous *O. mykiss*" (p. 122). In this regard, I also draw attention to the considerable discrepancy in Habitat Ratings between *Hunt and Associates* and *Kier Associates* on the degree to which the natural waterfall in Salmon Creek in the Big Sur Coast BPG constitutes a threat (see first page of Table D-2 of Appendix D in the Draft Recovery Plan).

In any event, I would suggest that the Draft Recovery Plan be revised to address (a) the questionable identification of natural waterfalls as a threat and (b) the inconsistency that is evident (to this reader) between the removal of the waterfalls and the overarching recovery objectives for the DPS.

(b) Use of Sterile Triploid Fish: Another of the DPS-wide recovery actions makes reference to use of sterile triploid fish where stocking is considered appropriate. Although not mentioned in the Draft Recovery Plan, there are caveats associated with the use of triploid fish: (a) the methods used to achieve sterility are not 100% effective and (b) the effectiveness of the method is very much dependent on the experience of the individual(s) applying the method. There is also the issue of whether the morphological deformities, characteristic of many triploid Atlantic salmon smolts that have been produced for aquaculture purposes, will serve as a deterrent for those who wish to continue to catch *O. mykiss* for recreational purposes.

(c) Effect of Dams on Anadromy: This may seem like a minor point (if only because its implicit assertions are generally not evident in the Draft Recovery Plan), but I am concerned about statements such as the one that appears on page 148 (lines 43-44). Here, it is stated that "Dams have also isolated native non-anadromous *O. mykiss* in the upper watersheds of these drainages that otherwise would be anadromous." No citation is provided in support of this assertion. Indeed, I would think it very difficult to locate a supporting citation. To be fair to the TRT, while it seems likely that *some portion* of the non-anadromous *O. mykiss* would likely become anadromous following dam removal (I saw exactly this in Atlantic salmon, *Salmo salar*, in Terra Nova National Park in eastern Newfoundland in 1983; following removal of a long-standing barrier generated by logging activities, some brook trout began migrating to the ocean; Hutchings 1985), I am unaware of any literature that would allow one to conclude that *all* previously non-anadromous fish would adopt the anadromous strategy following barrier removals. However, if such literature exists, it should be cited here.

4.2 EXTINCTION RISK ANALYSIS AND RECOVERY CRITERIA

The Technical Recovery Team has identified recovery objectives at the population level and at the DPS level. These have been articulated in Chapter 5 of the Draft Recovery Plan. Table 5-1 describes these criteria, specifies their thresholds, and provides accompanying notes.

The Population-Level Criteria pertain to: (i) annual spawning run abundance (i.e., run size); (ii) ocean conditions; (iii) density of spawners; and (iv) percentage of the population that is anadromous (as opposed to being resident, or non-anadromous). The Draft Recovery Plan states (p. 49) that these population-level criteria are to apply only to a subset of populations that have been identified as core populations.

Criterion 1: Run Size

(a) *Uncertainties in the 4150 Run Size Target*

The first criterion stipulates that each population achieve a run size at which the probability of extinction in the next 100 years is less than 5%. The estimated run size required to meet this criterion is 4150 spawners per year. The estimate originates from analyses undertaken by Boughton et al. (2007). The full suite of uncertainties associated with the 4150 estimate has been articulated by Boughton et al. (2007). However, I am concerned that not all of these uncertainties have been articulated in the Draft Recovery Plan as comprehensively as they might have been. I also think there is reason to believe that the 4150 run-size target represents an over-estimate.

The analysis undertaken by Boughton et al. (2007) seems sound, for the most part, based as it is on the modeling and analytical efforts undertaken by Foley (1994) and Lande (1993). The 4150 estimate hinges primarily on the values of r (the maximum per capita population growth rate) and V_r, the variance in r (i.e., environmental stochasticity). The estimate for V_r has a considerably stronger empirical basis (even though it is based primarily on data for Chinook salmon, *O. tshawytscha*, populations) than the estimate for r, which Boughton et al. (2007) set as 0.0953 for South-Central California Steelhead. I am concerned that this value of r that underpins the 4150 target for run size may be unduly low, meaning that the 4150 run size has been over-estimated, perhaps considerably. I draw upon three points in support of this suggestion.

Firstly, for comparison, and using the Euler-Lotka equation (to estimate age- or stage-structured population growth rates), I have estimated r for Snake River Fall Chinook Salmon and these estimates formed the basis for analyses presented by Williams et al. (2008) in which the fitness (measured as r) associated with yearling and sub-yearling smolt life histories was estimated and compared for different ages at maturity. For salmon maturing at age 4, for example, r was estimated to be 0.53 (stage-specific survival and fecundity estimates are presented in Williams et al. 2008). None of the population growth estimates was as low as 0.0953.

Secondly, Myers et al. (1999) estimated maximum population growth rates for a broad range of fishes. They provide estimates of $\log(R_0)$ in their paper (Table 1 in Myers et al. 1999). R_0 is a measure of net or lifetime reproductive rate. The equation $\log(R_0)/G$, where G is generation time, allows one to approximate r with reasonable accuracy (when compared, for example, with precise estimates from the Euler-Lotka equation).

Based on estimates of $\log(R_0)$ reported in Table 1 in Myers et al. (1999), and using rough approximations of generation time for each species, one can estimate r, where $r \sim \log(R_0)/G$:

Species	log(R_0)	Generation time	*r*
Pink salmon	1.22	2	0.61
Sockeye salmon	1.57	4	0.39
Chinook salmon	1.99	4 (or 5)	0.50 (or 0.40)
Chum salmon	1.31	3	0.44
Atlantic salmon	1.46	4	0.36

Lastly, I have been leading a nearly-completed, expanded analysis of the Myers et al. (1999) study in which we are examining the relationship between *r* and a variety of life history traits for terrestrial and aquatic vertebrates (Hutchings et al. 2009MS). Our estimates of *r* for several salmonids, based on the methodology described by Myers et al. (1997, 1999), are as follows:

Species	Number of populations	Mean estimate of *r* (range in *r* in parentheses)
Pink salmon	51	0.68 (0.11,1.38)
Sockeye salmon	32	0.35 (0.13, 0.64)
Chinook salmon	6	0.42 (0.33, 0.58)
Atlantic salmon	3	0.29 (0.17, 0.37)
Brook trout	5	1.05 (0.83, 1.35)

Based on the information provided above, an estimate of *r* (maximum per capita rate of population growth) of at least 0.30 may provide a more scientifically defensible, yet still precautionary, value for the South-Central California Steelhead DPS.

One additional reason for surmising that the estimate of 4150 might be too high (a possibility noted on p. 200 of the Draft Recovery Plan) is based on the conclusion that annual runs of anadromous *O. mykiss* populations within the South-Central California Steelhead DPS are estimated to have totaled 27,000 returning adults historically (page 18). Unless I have misinterpreted this information, the attainment of an annual run size of 4150 for many steelhead populations would seem to produce an overall number of steelhead spawners considerably in excess of the 27,000 that comprise the historical estimate (perhaps the historical estimate is too low?).

An additional consideration is the fact that the estimated run size of 4150 spawners per year appears to be extremely sensitive to the level of managerial risk tolerance. If I have interpreted Boughton et al. (2007) correctly, the target run size changes with the risk extinction probability over 100 years as follows:

94% risk tolerance: >2000 spawners per year
95% risk tolerance: 4150 spawners per year
96% risk tolerance: >11,000 spawners per year

Incidentally, one might argue that a 5% extinction probability target is too low. For example, the IUCN criteria stipulate that a species is to be assigned a status of

Vulnerable (essentially the same as 'Threatened' in the U.S.) if the probability of extinction over the next 100 years exceeds 10% (IUCN 2008).

As an aside, when reference is made to average run size, the TRT might consider the degree to which they prefer the *arithmetic mean* to the *geometric* or *harmonic mean*. Life-history theorists, population biologists and evolutionary ecologists have long recognized that the fitness (r) associated with a particular genotype or life history should be estimated as the geometric mean of the fitness estimates. Use of the geometric mean makes implicit the fact that fitness is determined by a multiplicative process: the total number of descendants left by an individual after n generations depends on the product of the number surviving to reproduce in each generation. The geometric mean fitness of genotype i after n generations can be calculated as

$$((r(\mathrm{i})_1)\times(r(\mathrm{i})_2)\times(r(\mathrm{i})_3)\times(r(\mathrm{i})_4)\times\ldots\times((\mathrm{i})_n))^{(1/n)} \quad .$$

Importantly, the more variable a set of values, the lower the geometric mean. Thus, selection should act to reduce the variance in genotypic/individual fitness over generations, even if this entails a "sacrifice" of the expected fitness within any one generation. Such a "bet-hedging" life history strategy is manifested by the spreading of reproductive risk across space and time.

Note also that the geometric mean is strongly influenced by low values, a fundamental point noted in various sections of the Draft Recovery Plan (e.g., when discussing poor ocean conditions). The same logic can, and arguably should, be applied when identifying targets and thresholds for the levels of spawner abundance required to ensure that the probability of extinction over the next 100 years is less than 5%.

Although few (if any) recovery plans acknowledge the utility of geometric means over arithmetic means, it might be useful for the TRT to consider whether a geometric average of 4150 spawners per year might preferable to an arithmetic average of 4150 spawners per year.

(b) ***Habitat-Dependent or Habitat-Independent Run-Size Targets?***
The target of 4150 spawners per year is one intended to be applied to populations apparently independent of the habitat capacity of each river/population to produce this number of spawners. Notwithstanding the inherent difficulties in establishing firm population targets for recovery, there is considerable merit, importantly from a communications perspective, in identifying *some* quantitative targets for variables such as minimum number of spawners. It illustrates to those reading the recovery plan that quantitative targets *can* be specified on a population by population basis, while acknowledging that data deficiencies may prevent the establishment of such targets for all populations at present.

In eastern Canada, for example, conservation requirements for spawner escapement (run size) are based on region-wide, juvenile-habitat based targets. Specifically, the spawning escapement required to meet the conservation target of a particular population have been based on the number of eggs per unit area of fluvial rearing habitat (or lacustrine rearing habitat in Newfoundland) estimated to maximise the number of smolts (anadromous migrants) produced by each population. Maximal smolt production is estimated to be achieved by an egg deposition of 240 eggs $100m^{-2}$ of fluvial rearing habitat. (In the early 1990s, in acknowledgement of the importance of lakes and ponds to the production of salmon in Newfoundland, spawning requirements for several Newfoundland rivers were defined based on the additional requirement of 1.05 or 3.68 eggs $100m^{-2}$ of lacustrine habitat, depending on latitude.)

The conservation egg requirement of 240 eggs $100m^{-2}$ of fluvial rearing habitat has been transported to all Canadian Atlantic salmon rivers. To date, this conservation egg requirement has been defined for 55 rivers and all Salmon Fishing Areas in Newfoundland, and for more than 150 rivers in the Canadian Maritime provinces of Nova Scotia, New Brunswick, and Prince Edward Island. The conservation targets for the 110 salmon rivers in Québec are also based on egg deposition rates predicted to maximize salmon productivity.

Based on the information provided by Boughton et al. (2006), it would appear as though a considerable amount of data on steelhead habitat has been collected for rivers within the range of DPS, potentially making such habitat-based conservation targets quantifiable.

Criterion 2: Ocean Conditions
While I understand the need for the run size of each population to be sufficiently high so that it can be met during periods of poor ocean survival, I do wonder whether this necessity is best articulated as a full-fledged recovery criterion. Among other things, one is dealing with a moving target when trying to ascertain the poorest conditions. Waiting for a period of 60 years (as suggested by point 1 on page 51), for a part of a climate cycle that may or may not exist, strikes me as being problematic as well. Point 2 (page 51) may identify the more appropriate of the two proposed courses of action (i.e., initiate and continue appropriate monitoring programs, using data collected on smolt and adult counts). (In any event, given the 4-5 year generation time of steelhead, all one requires is 4-5 consecutive years of poor survival to have significantly negative consequences on population persistence.) I also note that the potential exclusion of this criterion is raised in the last paragraph of the section entitled "Criterion P.2 – Ocean Conditions" (p. 52) of the Draft Recovery Plan.

Criterion 3: Spawner Density
I understand and agree with the need for information on spawner density. However, it might be advantageous if the Draft Recovery Plan provided further elaboration on this criterion (p. 52). For example, it might be useful to aim for a minimum spawner density, for a specific type of spawning substrate, rather than to aim for an average spawner density for each population.

Secondly, there is the question of how steelhead distribute themselves during spawning as density increases. In theory, as spawner density at the preferred spawning substrate/habitat increases, one would expect less desirable spawning substrates/habitat to be increasingly utilized, on the basis of the expectations of the Ideal Free Distribution. My point here is that aiming for an average spawner density might be more problematic than aiming for a minimum spawner density, unless one has comprehensive knowledge of the availability of different spawning habitats throughout each population.

Thirdly, given this point (differential use of different spawning habitats as density increases), the situation could arise where the minimum run size threshold of 4150 spawners is met, but the spawner density target is not met.

These arguments may be moot if steelhead are known to spawn in only one type of spawning substrate and in a restricted area of each river.

Criterion 4: Anadromous Fraction
One of the premises for including this criterion is that the lack of data on 'rescue effect' from resident rainbow trout should lead one to the conclusion that:

> "the prescriptive criterion for anadromous fraction must assume that the rescue effect is negligible, and that anadromous fraction must be 100% -- that is, when applying the population size criterion discussed previously, 100% of the spawners must be anadromous".

I am unable to agree with this criterion. I appreciate that it is meant to be applied only to the core populations, but I disagree with it nonetheless. The Draft Recovery Plan makes it clear, in many places, that non-anadromous *O. mykiss* may well be critically important to the recovery of South-Central California Steelhead and to their eventual delisting from the Endangered Species Act. Indeed, Recovery Objectives 3 and 5 (page 47) are, respectively, to [*italics* added]:

- Increase abundance of steelhead to viable population levels, *including the expression of all life history forms and strategies*
- Maintain and restore suitable habitat conditions and characteristics *to support all life history stages of viable populations.*

Striving to achieve 100% anadromy seems to be inconsistent with the above italicized parts of the Recovery Objectives. I might suggest that the target be defined along the lines of “most (>80%) of the mean annual run size is comprised of anadromous individuals”. Although the threshold of 80% is clearly arbitrary, it would provide for a target at which most spawners are anadromous, while acknowledging that all need not, and perhaps should not, be anadromous.

Also, I note that Population-Level Criterion P.4 Anadromous Fraction is not mentioned explicitly in the detailed discussion of the Viability Criteria beginning on pages 185-186. Given the impressively comprehensive nature of the Draft Recovery Plan, I cannot help but wonder if this omission might reflect an undefined level of unease with this criterion.

The criterion is, however, alluded to implicitly in the statement that:

> "In the absence of specific information about the role of life-history crossovers, the TRT took a precautionary approach (i.e., it was assumed that there was not any beneficial effect of crossovers)."

I find this to be a curious use of the term "precautionary approach". The Precautionary Approach recognizes that the absence of full scientific certainty shall not be used as a reason for postponing decisions where there is a risk of serious or irreversible harm. In the present case, "serious or irreversible harm" would be the extirpation or extinction of (i) populations, (ii) core populations, (iii) Biogeographic Population Groups, or (iv) the South-Central California Steelhead DPS.

There may well be a lack of full scientific certainty that crossing-over between anadromous and non-anadromous *O mykiss* is beneficial to steelhead. But I would argue that this lack of full scientific certainty makes the case, if one is going to apply the Precautionary Approach that one should assume that such crossing-over exists and that it contributes to the persistence and sustainability of steelhead, rather than the opposite.

Indeed, there is considerable evidence (as the TRT has noted) that non-anadromy and anadromy exist within the same biological species, indeed within the same river system, and possibly within the same population, in many salmonid fishes. Examples include Arctic char (*Salvelinus alpinus*), brook trout (*S. fontinalis*), Atlantic salmon, and brown trout (*Salmo trutta*).

I have considerable experience with the study of co-existing forms of anadromous and non-anadromous Atlantic salmon in Newfoundland. Although rare in Europe, non-migratory populations of Atlantic salmon are not uncommon in eastern North America. Variously termed ‘ouananiche’ or ‘landlocked salmon’, these populations inhabit waters that may or may not have barriers to migration to and from the sea. In Maine (where they are called ‘lake’ or Sebago salmon) and Québec, the populations are truly landlocked, preventing genetic or ecological interactions with anadromous populations. However, throughout Newfoundland, where non-migratory salmon are most abundant, ouananiche frequently co-exist with anadromous populations in system where barriers to seaward migration do not exist.

Not only does this co-existence raise interesting questions concerning the evolutionary stability of both life history forms (e.g., Hutchings 1986), but it also has consequences for the establishment of reference points for stock assessment. For systems containing both anadromous and non-anadromous forms, a key challenge has been the setting of conservation targets that are based solely on numbers of anadromous fish returning to spawn. It may not be uncommon for a system to have reached its maximum juvenile-rearing capacity to produce *S. salar* but <u>not</u> to have met its conservation target for anadromous salmon in the same system.

From a research perspective, it has indeed long been recognized that a key challenge is to identify the ecological and evolutionary mechanisms permitting the coexistence of anadromous and non-anadromous population of salmon -- indeed all salmonids – in systems in which physical barriers to seaward migration are absent. Given the lack of evidence of temporal or behavioural isolating mechanisms (Hutchings and Myers 1985), the probability of interbreeding between Atlantic salmon life-history forms, for example, may be primarily attributable to spatial differences in the availability of spawning habitat. Hutchings (1986) predicted that interbreeding between forms would be high in systems for which spawning habitat was limited. Couturier et al. (1986) suggested that the probability of reproductive isolation between resident and migrant salmon may be substantial in watersheds characterized by multiple potential spawning locations.

In other words, the probability of interbreeding between resident and migratory forms may primarily be a consequence of the availability of suitable spawning habitat and by the way in which that habitat is distributed throughout the river system (contiguous spawning habitat patches being more likely to lead to interbreeding between residents and migrants, rather than non-contiguous patches). Alternatively, and as the TRT has noted in the Draft Recovery Plan, if the two life history forms are a product of phenotypic plasticity, changes to growth rate and/or survival probabilities at sea may favour an increase in the incidence of non-anadromy in such populations.

Future research may shed some additional insights into the probabilities that resident strategies (i.e., rainbow trout form) will be favoured over the anadromous (steelhead) form. A key element in this regard is the estimation of age-, size-, and stage-specific survival probabilities associated with various stages of life (e.g., egg, fry, parr, smolt, adult), particularly those that include habitat in fresh water. I strongly support and encourage the proposed research and monitoring initiatives in the Draft Recovery Plan that focus on the estimation of these survival probabilities for South-Central California Steelhead.

I would also suggest that it is unlikely that a genetic analysis will unequivocably allow one to conclude that resident forms of *O. mykiss* do not contribute (genetically, or indeed demographically) to the persistence of anadromous forms of *O. mykiss*.

4.3 ESTIMATED TIME TO AND COST OF RECOVERY

Although the Draft Recovery Plan does not specify a specific timeline for recovery, it does suggest that cost estimates for implementing recovery actions over the first five fiscal years are included (or will be included) in the Plan, specifically in the tables describing the Recovery Action Matrixes for each of the BPGs. However, none of these costs are provided in the current draft of the recovery plan. The Draft Recovery Plan notes that an implementation schedule describing time frames and costs associated with individual recovery actions is under development, drawing attention to the considerable challenges associated with estimating the total costs for recovery actions.

Appendix C of the Draft Recovery Plan does provide cost estimates for various Restoration Activities (e.g., instream barrier modifications, channel restoration projects, fish ladder installation, stream habitat restoration and stabilization). However, from a communications perspective, these estimates are not presented in a helpful manner. In addition to not being summed either by population (river or creek) or by Biogeographic Population Group, there are no sum totals of estimated costs provided.

The ESA states that a Draft Recovery Plan must include timelines and costs for recovery to the maximum extent practicable. I think it is fair to conclude that the Recovery Plan does not yet meet this criterion, insofar as one can question whether the *maximum extent practicable* has indeed been attained in the Recovery Plan. However, once the cost estimates over the next 5 fiscal years have been included in the Plan, this criterion, as it pertains to costs, can be said to be met.

I also would have appreciated some simulation analyses to underpin estimates of time to recovery. These would, I suspect, be no more uncertain than the estimates of run size required to ensure that populations have a 95% probability of persistence over a 100-year time frame.

4.4 RESEARCH AND MONITORING RECOMMENDATIONS

The Draft Recovery Plan does an excellent job of articulating the research and monitoring requirements associated with the recovery of the South-Central California Steelhead DPS (Chapter 12). I generally agree with the tenor of the proposed research initiatives.

Regarding the idea of establishing Conservation Hatcheries (p. 213), I might suggest that such a venture only be initiated as a last resort. The Draft Recovery Plan has appropriately identified the potential drawbacks associated with the introduction of hatchery-reared fish in wild populations. In this regard, I might draw the TRT's attention to recent reviews of (1) the fitness consequences resulting from genetic interactions between wild salmonids and their cultured/hatchery counterparts (Hutchings and Fraser 2008) and (2) the role of captive breeding programs to the conservation of biodiversity in salmonids (Fraser 2008).

5 SUMMARY OF FINDINGS MADE BY THE CIE PEER REVIEWER

The primary findings of this peer reviewer are encompassed by the previous section and summarized in the section following.

6 CONCLUSIONS and RECOMMENDATIONS

6.1 CONCLUSIONS

Based on the Terms of Reference in Annex 1 of the Statement of Work (Appendix B), I have used the CIE Peer Reviewer Questions as a template for the conclusions that follow.

1. In general, the Draft Recovery Plan includes and cites the best scientific and commercial information available on *Oncorhynchus mykiss* and on the South-Central California Steelhead DPS and its habitats, including threats to the species, its habitat, and large-scale perturbations, such as climate change and ocean conditions. I have identified some additional literature (notably with respect to the estimation of a target run size) that may, in some measure, serve to strengthen the Recovery Plan.

2. The Draft Recovery Plan identifies, and discusses the potential consequences of, uncertainties associated with the recommendations made by the Plan. Studies and theories that might be viewed to be in opposition to the Plan's findings and recommendations have, in my opinion, been acknowledged and discussed.

3. For the most part, I would judge most of the scientific conclusions to be sound and to have been derived logically from the results. The proposed targets for annual run size and percent anadromy probably merit re-examination.

4. With two possible exceptions, the Draft Recovery Plan meets the requirements of a recovery plan as defined in section 4(f)(1) of the ESA, and sections 1.1 and 1.2 of the NMFS Interim Recovery Planning Guidance (NMFS 2006). The ESA states that a Recovery Plan must include timelines and costs for recovery to the maximum extent practicable. I think it is fair to conclude that the Draft Recovery Plan does not yet meet this criterion, insofar as one can question whether the *maximum extent* has indeed been attained in the Plan. However, once the cost estimates over the next 5 fiscal years have been included, this criterion, as it pertains to costs, can be said to be met. Regarding timelines, as far as I can tell, timelines for recovery have not been estimated in Plan. I would have appreciated some simulation analyses to underpin estimates of time to recovery. These would, I suspect, be no more uncertain than the estimates of run size required to ensure that populations have a 95% probability of persistence over a 100 year time frame.

5. The Draft Recovery Plan provides a clear presentation of the extinction risk faced by the South-Central California Steelhead DPS, the threats faced by the DPS, and the necessary actions to remove or reduce the threats such that the recovery objectives can be achieved.

6. For the next 1-2 decades, the recovery strategy and overall recovery plan provide clear guidance to all those involved in recovery activities to promulgate

the recovery of the South-Central California Steelhead DPS. Although the question posed is whether clear guidance has been provided for the "next several decades", the Plan appropriately does not extend too far in the future. Rather, it proactively identifies means by which some form of adaptive management can be affected, such that the clarity and utility of guidance provided by the Technical Recovery Team will be enhanced as time progresses.

6.2 RECOMMENDATIONS

1. That additional analysis be undertaken to estimate the mean annual run size that would provide for a 95% chance of population persistence over a period of 100 years, i.e., Recovery Criterion P.1. The current estimate or 4150 spawners per year is highly dependent on the maximum per capita population growth rate (*r*) that is used in the analysis. The model estimate that underpins the 4150 run-size target is based on an input value of *r* of 0.0953. There is reason to believe that the *r* of South-Central California Steelhead may be higher than the estimate used in the analysis, which would lead to a corresponding reduction in the run-size target. Based on the data provided in this review, an estimate of *r* of at least 0.30 may provide a more scientifically defensible, yet still precautionary, value.

2. That inclusion of Recovery Criterion P.2 on Ocean Conditions be re-evaluated and possibly deleted. Elimination of this criterion would not negate the necessity of concurrently monitoring run size and steelhead survival at sea, but it would render the criterion more quantitatively tractable.

3. That the potential utility of habitat-based conservation targets for run size be considered. Such estimates might be based, for example, on target egg deposition rates per unit area of suitable spawning substrate, or juvenile rearing habitat.

4. That Recovery Criterion P.4 Anadromous Fraction be revised. The Plan advocates, with some qualification, a target of 100% anadromy among spawning fish. A revised target of, say, ">80% anadromy" would underscore the importance, and perhaps conservation necessity, of having both anadromous and resident (but primarily anadromous) spawners contributing genes to future generations. A target of less than 100% would also be more consistent with the over-arching recovery objectives for the South-Central California Steelhead DPS and would, I suggest, be more precautionary.

5. That the identification of natural waterfalls, such as those on Salmon Creek, as a significant threat to the persistence of steelhead in some rivers, and the sanctioned removal of natural waterfalls as a Recovery Action, be reconsidered.

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APPENDIX B: STATEMENT OF WORK

External Independent Peer Review by the Center for Independent Experts

South-Central California Coast Steelhead Draft Recovery Plan

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract to provide external expertise through the Center for Independent Experts (CIE) to conduct impartial and independent peer reviews of NMFS scientific projects and to participate in resource assessments involving NMFS. The Statement of Work (SoW) described herein was established by the NMFS Contracting Officer's Technical Representative (COTR) and CIE based on the resource assessment requirements submitted by NMFS Project Contact. CIE appointees are selected by the CIE Coordination Team and Steering Committee to conduct the peer review of NMFS science and to participate in resources assessments with project specific Terms of Reference (ToRs). The CIE appointee shall produce a CIE independent report of the appointee's involvement with specific format and content requirements (**Annex 1**). This SoW describes the CIE appointee's work tasks and deliverables related to the following NMFS resource assessment project.

Further information on the CIE peer review process can be obtained at the CIE website via: http://www.iexperts.gogax.com/index.html.

Project Background: The Endangered Species Act (ESA) requires NOAA's National Marine Fisheries Service (NMFS) to develop and implement recovery plans for the conservation of threatened and endangered species. The threatened South-Central California Distinct Population Segment (DPS) of steelhead occur in an area extending from the Pajaro River south to, but not including, the Santa Maria River. The geographic area of this DPS contains a series of large river basins that extend inland considerable distances and short coastal systems, some with within urbanized areas. The draft recovery plan serves as a guideline for achieving recovery goals by describing the watersheds and recovery actions that must be taken to improve the status of the species and their habitats. Although the recovery plan itself is not a regulatory document, its primary purpose is to provide a conservation "road map" for Federal and state agencies, local governments, non-governmental entities, private businesses, and stakeholders.

The NMFS Recovery Plan for the south-central California steelhead is expected to generate substantial interest from outside parties because it: (1) will contain recommendations involving water supplies for a variety of municipalities and agricultural users in an area of low annual rainfall; (2) will prioritize watersheds for targeted restoration actions; (3) could influence local and regional planning efforts and decisions involving land-development patterns; and (4) advise state agencies and local governments on actions necessary to further improve land-use and water-management practices to protect the listed species and its freshwater habitats. The draft recovery plan will include a large geographic area in southern California and has the potential for wide-ranging implications in the public and private sectors. Stakeholder interest will be high due to the potential impact to millions of south-central Californians and is expected to lead to inquiries from elected representatives at the local, state and Federal levels.

Requirements for CIE Reviewers: CIE shall provide three CIE reviewers to conduct a desk peer review (i.e., without travel requirement) of NMFS Draft South-Central California Coast Steelhead Recovery Plan to ensure that its contents can be factually supported and that the methodology and conclusions are scientifically valid. The area under consideration will be the lands and waterways in south-central California. The desk review will be conducted in accordance with the ToRs, SoW tasks, and schedule of milestones and deliverables as described herein. The location of the peer review does not need to occur on site. Draft documents can be mailed to reviewers.

Each reviewer's duties shall not exceed a maximum of ten work days. Each reviewer shall analyze the relevant Technical Memoranda developed by NMFS Technical Review Team (TRT) for the South-Central/Southern California Coast Steelhead Recovery Planning Domain as well as the draft Southern California Coast Steelhead Recovery Plan and develop a detailed report in response to the ToR (Annex 1). The reviewers shall conduct their analyses and writing duties from their primary locations. Each written report is to be based on the individual reviewer's findings. See Annex II for details on the report outline.

CIE reviewers shall have expertise in steelhead management, conservation biology, steelhead restoration practices, steelhead/water management, and steelhead conservation under the ESA. Additionally, because of the many unique physical/hydrological aspects of habitat at the southern extent of the species range and the special adaptations of the species to this habitat, it is important that peer reviewers have familiarity with south-central California steelhead biology and conservation issues. NMFS requests the review be conducted by reviewers with strong credentials in west coast steelhead management activities under the Endangered Species Act.

The CIE reviewers shall have the requested expertise necessary to complete an impartial peer review and produce the deliverables in accordance with the SoW and ToR as stated herein (refer to the ToR in Annex 1).

Statement of Tasks for CIE Reviewers: The CIE reviewers shall be required to complete the following four tasks: Task 1 - conduct necessary preparations prior to the peer review; Task 2 - conduct the peer review; Task 3 – prepare independent CIE peer review draft reports in accordance with the ToR and milestone dates as specified in the Schedule section; and, Task 4 – Revise draft reports to produce final reports in accordance with the ToR and milestone dates as specified in the Schedule section. Each task is described more fully below.

<u>Task 1 - Necessary Preparation Prior to the Peer Review</u>: The CIE shall provide the CIE reviewers contact information (name, affiliation, address, email, and phone) to the Office of Science and Technology COTR no later than the date as specified in the SoW, and this information will be forwarded to the Project Contact.

Approximately two weeks before the peer review, the Project Contact will send the CIE reviewers the necessary documents for the peer review, including supplementary documents for background information. The CIE reviewers shall read the background documents for the actual peer review.

This list of background documents may be updated up to two weeks before the peer review. Any delays in submission of background documents for the CIE peer review will result in delays with the CIE peer review process. Furthermore, the CIE reviewers are responsible for only the background documents that are delivered to them in accordance to the SoW scheduled deadlines specified herein.

Task 2 - Conduct the Peer Review: The reviewers shall conduct their analyses and writing duties from their primary locations as a "desk" review. Each written report is to be based on the individual reviewer's findings and no consensus report shall be accepted.

The primary role of the CIE reviewer is to conduct an impartial peer review in accordance to the Terms of Reference (ToR) herein, to ensure the best available science is utilized for the National Marine Fisheries Service (NMFS) management decisions (refer to the ToR in Annex 1).

The ToR for the CIE peer review is attached to the SoW as Annex 1. Up to two weeks before the peer review, the ToR may be updated with minor modifications as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToR are not adversely impacted. Please see Annex 1 attached.

Task 3 - Prepare Independent CIE Peer Review Draft Reports: The primary deliverable of the SoW is each CIE reviewer shall complete and submit an independent CIE peer review report in accordance with the ToR, and this report shall be formatted as specified in the attached Annex 2.

Task 4 - Revise Draft Reports to Produce Final Reports: Following a review of their reports by the CIE technical team, reviewers will revise their draft reports, to produce written final reports. Reviewers will submit their final reports to the CIE.

Schedule of Milestones and Deliverables: The CIE review and milestones shall be conducted in accordance with the dates below.

10 July 2009	CIE shall provide the COTR with the CIE reviewer contact information, which will then be sent to the Project Contact
17 July 2009	The Project Contact will send the CIE Reviewers the pre-review documents
17-31 July 2009	Each reviewer shall conduct an independent peer review
31 July 2009	Each reviewer shall submit an independent peer review report to the CIE
14 August 2009	CIE shall submit draft independent peer review reports to the COTRs
21 August 2009	The COTRs will distribute the final CIE reports to the Project Contact

Acceptance of Deliverables: Each CIE reviewer shall complete and submit an independent CIE peer review report in accordance with the ToR, which shall be formatted as specified in Annex 2. The report shall be sent to Manoj Shivlani, CIE lead coordinator, via shivlanim@bellsouth.net and to Dr. David Die, CIE regional coordinator, via ddie@rsmas.miami.edu . Upon review and acceptance of the CIE reports by the CIE, the CIE shall send via e-mail the CIE reports to the COTR (William Michaels William.Michaels@noaa.gov) at the NMFS Office of Science and Technology by the date in the Schedule of Milestones and Deliverables. The COTRs will review the CIE reports to ensure compliance with the SoW and ToR herein, and have the responsibility of approval and acceptance of the deliverables. Upon notification of acceptance, CIE shall send via e-mail the final CIE report in *.PDF format to the COTRs. The COTRs at the Office of Science and Technology have the responsibility for the distribution of the final CIE reports to the Project Contacts.

Request for Changes: Requests for changes shall be submitted to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the Contractor within 10 working days after receipt of all required information of the decision on substitutions. The contract will be modified to reflect any approved changes. The Terms of Reference (ToR) and list of pre-review documents herein may be updated without contract modification as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToR are not adversely impacted.

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ANNEX 1

Terms of Reference

CIE Peer Review of California's South-Central California Coast Steelhead Draft Recovery Plan

The scope of work should focus on the principal elements required in a recovery plan. These principal elements have been defined in section 4(f)(1) of the federal Endangered Species Act (ESA) and sections 1.1 and 1.2 of the National Marine Fisheries Service Interim Recovery Planning Guidance (NMFS 2006)

Section 4(f)(1)(b) of ESA states that "each plan must include, to the maximum extent practicable,

- a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;
- objective, measurable criteria which, when met, would result in a determination…that the species be removed from the list; and,
- estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal."

From section 1.1 of NMFS (2006), a recovery plan should:

- "Delineate those aspects of the species' biology, life history, and threats that are pertinent to its endangerment and recovery;
- Outline and justify a strategy to achieve recovery;
- Identify the actions necessary to achieve recovery of the species; and
- Identify goals and criteria by which to measure the species' achievement of recovery."

Background Materials Required
There are five NMFS Science Center Technical Memoranda that form the biological framework for the recovery plan. These memoranda and other supporting information are critical to the review of the Draft NCCC Recovery Plan and include:

- Technical Recovery Team Reports:
- Historical Structure
- Viability Criteria
- Contraction of the southern range limit for anadromous Oncorhynchus mykiss
- Recent efforts to monitor anadromous Oncorhynchus species in the California coastal region: a compilation of metadata
- Potential steelhead over-summering habitat in the South-Central/Southern California Coast Recovery Domain: maps based on the envelope method

In addition, other important references include

- 2006 (2007 Updates) NMFS Interim Recovery Planning Guidance
- Endangered Species Act (http://www.nmfs.noaa.gov/pr/pdfs/laws/esa.pdf)

- Derek Girman and J. C. Garza. (2006) Population structure and ancestry of O. mykiss populations in South-Central California based on genetic analysis of microsatellite data. 33pp.
- Garza, J. C., and A. C. Clemento. (2008) Population genetic structure of */Oncorhynchus mykiss/* in the Santa Ynez River, California. 55pp.

CIE Peer Reviewer Questions:

Evaluate the adequacy, appropriateness and application of data used in the Plan.

1. In general, does the Plan include and cite the best scientific and commercial information available on the species and its habitats, including threats to the species and to its habitat including large-scale perturbations such as climate change and ocean conditions?
2. Where available, are opposing scientific studies or theories acknowledged and discussed?
3. Are the scientific conclusions sound and derived logically from the results?

Evaluate the recommendations made in the Plan.

1. Does the Plan meet the minimum standards for recovery plans outlined in the NMFS Interim Recovery Guidance and mandates described in section 4(f)(1)(b) of ESA to include site-specific management actions, objective measurable criteria (criteria that links to listing factors) and estimates of time and cost?
2. Is there a clear presentation of the species' extinction risk, the threats facing the species and the necessary actions to remove or reduce those threats such that recovery goals can be achieved?
3. Does the recovery strategy and overall recovery plan provide clear guidance for the public, restorationists, managers, regulators and others to act in a relevant manner over the next several decades to promulgate recovery of salmon and steelhead.
4. Review the research and monitoring recommendations made in the Report and make any additional recommendations, if warranted.

ANNEX 2

Format and Contents of CIE Independent Reports

The report should follow the outline given below. It should be prefaced with an Executive Summary that is a concise synopsis of goals for the peer review, findings, conclusions, and recommendations. The main body of the report should provide an introduction that includes a background on the purpose of the review, the terms of reference and a description of the activities the reviewer took while conducting the review. Next, the report should include a summary of findings made in the peer review followed by a section of conclusions and recommendations based on the terms of reference. Lastly the report should include appendices of information used in the review (see outline for more details).

1. Executive Summary
    a. Impetus and goals for the review
    b. Main conclusions and recommendations
    c. Interpretation of the findings with respect to conclusions and management advice

2. Introduction
    a. Background
    b. Terms of Reference
    c. Description of activities in the review

3. Review of Information used in the Recovery Plan (as outlined in the table of contents in the Recovery Plan)

4. Review of the Findings made in the Recovery Plan
    a. DPS considerations: Populations, Habitats and Threats
    b. Extinction Risk Analysis and Recovery Criteria
    c. Evaluation of Conservation Measures
    d. Research and Monitoring Recommendations

5. Summary of findings made by the CIE peer reviewer

6. Conclusions and Recommendations (based on the Terms of Reference in Annex I)

7. Appendices
    a. Bibliography of all material provided
    b. Statement of Work
    c. Other