

**Reviewer's Report for:**

**SOUTH-CENTRAL CALIFORNIA COAST  
STEELHEAD DRAFT RECOVERY PLAN**

Prepared by

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## **1. EXECUTIVE SUMMARY:**

### **1.1 Impetus and goals for the review**

- This review was undertaken to evaluate the National Marine Fisheries Service (NMFS) Draft Recovery Plan for South-Central California Coastal (SCCC) Steelhead. This is part of the formal public review process required under the Endangered Species Act (ESA) before the final Plan is approved.
- The primary purpose of the review was to determine whether the Draft Recovery Plan meets the requirements of the (ESA) and the NMFS Interim Recovery Planning Guidance (NMFS, 2007).

### **1.2 Main conclusions and recommendations**

- The Recovery Plan does not fully satisfy the requirements of Section 4(f)(1)(b) of the ESA. First, the Plan identifies a range of recovery actions but it is not clear what proportion need to be addressed to ensure a high probability of restoring the SCCC steelhead DPS. Second, recovery thresholds have yet to be defined for several of the proposed recovery criteria and so these cannot be classed as objective and measurable; while this largely reflects the paucity of data on SCCC steelhead populations, there is a need to describe the interim objectives and criteria, which will be used for the short-term, and to describe the actions necessary and timelines to obtain the pertinent information and develop recovery objectives and criteria. Third, the Plan also fails to provide estimates of the time and cost to carry out the recommended recovery measures.
- The requirements of NMFS (2007) are all addressed to some degree, but there are significant failings in most areas. The Plan includes some proposals for site specific management actions but in general the proposals are still relatively vague. As indicated above, the criteria are not generally objective or measurable and they lack estimates of time and cost.

### **1.3 Interpretation of the findings with respect to conclusions and management advice**

- The Recovery Plan indicates that a threat assessment process was undertaken using the ‘Conservation Action Planning’ (CAP) Workbook process, but insufficient information is provided on the process itself and on the way that it was employed. In addition there is some confusion between the classification of threats and sources of threats. As a result the identification and prioritisation of threats is generally unclear.
- There are significant difficulties establishing recovery criteria because there is very little data on steelhead populations within the SCCC area. Several of the recovery criteria are currently provisional or unquantified and therefore require further research. It appears questionable whether these should be included as recovery criteria within the Plan at this stage since they clearly fail to meet the requirement of objectivity and measurability. Instead, the Recovery Plan should describe clear

interim objectives and criteria, which will be used for the short-term until better delisting objectives and criteria can be determined. In addition to explaining why these objectives/criteria are undeterminable at present, the Plan should include the actions necessary and timelines to obtain the pertinent information and develop recovery objectives and criteria once the information is obtained this is only partially addressed at present.

- The Recovery Plan identifies a large number of recovery actions which will clearly address potentially significant problems and assist in the recovery of the SCCC steelhead DSP. However these actions are poorly structured such that they are not related to the recovery objectives or the listing factors, and it is not always possible to clearly identify where actions may be inter-related or conditional upon each other. Furthermore they do not identify timelines, durations, costs or responsible parties, and so the lists do not provide a clear basis for prioritising activities within a recovery programme. No consideration is given to benefit/cost analysis to assist in identifying and prioritising appropriate actions.
- The large number of research and monitoring requirements reflects the current lack of information on steelhead populations in the SCCC area. The proposed work will generally support the recovery of the DPS, although the proposals could usefully be clarified to remove apparent overlaps.

## **2. INTRODUCTION**

### **2.1 Background**

Populations of steelhead (*Oncorhynchus mykiss*) along the west coast of the United States have experienced substantial declines in abundance as a result of human activities such as water management, flood control, agriculture and urbanisation that have degraded, simplified and fragmented their freshwater and estuarine habitats. In south central California, near the southern limit of the range for anadromous *O. mykiss* in North America, it is estimated that annual runs have declined from 27,000 returning adults historically, to less than 1,000 returning adults today. Steelhead in south central California comprise a ‘distinct population segment’ (DPS) of the species *O. mykiss* that is ecologically and reproductively discrete from the remainder of the species along the West Coast. Therefore, under the Federal Endangered Species Act of 1973 (ESA), this DPS qualifies for protection as an individual ‘species’. In 1997, the South Central California Steelhead (SCC) DPS was first listed as a ‘threatened’ species, or a species that is likely to become in danger of extinction in the foreseeable future.

The ESA requires NOAA’s National Marine Fisheries Service (NMFS) to develop and implement recovery plans for the ‘conservation and survival of endangered species and threatened species’ (unless it is found that such a plan will not promote the conservation of the species). Furthermore Section 4(f)(1)(b) of ESA states that each plan shall incorporate [to the maximum extent practicable]:

- “(i) 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;
- (ii) objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list; and
- (iii) 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.”

There is also a requirement to provide public notice and an opportunity for public review and comment on such a Plan before final approval of the plan or a new or revised version. NMFS completed a draft Recovery Plan in July 2009 (NMFS, 2009), and this report forms part of this review process.

### **2.2 Terms of Reference**

The full Terms of Reference for the ‘CIE Peer Review of California’s South-Central California Coast Steelhead Draft Recovery Plan’ are provided in Annex 1 of Appendix 2. This lists the following four Tasks to be undertaken:

**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.

With respect to Task 2, the ToR indicate that the review should focus on the principal elements required in a recovery plan (listed above) and specifies the following issues to be addressed within the peer review:

**A. 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?

**B. 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.

Instructions are provided for the format and contents of the peer-review report (Appendix 2, Annex 1)

### **2.3 Description of Review Activities**

I have undertaken this review (Tasks 1 to 3 of the ToR) as a desk exercise based at Cefas's Lowestoft Laboratory, England. The CIE provided, by email, a copy of the report to be reviewed:

**National Marine Fisheries Service (2009) South-Central California Steelhead Recovery Plan. Internal Review Draft Version: July 2009. 363pp.**

I also received a CD containing an additional eight background documents, five NMFS Science Centre Technical Memoranda, plus two reports and a copy of a published paper all relating to steelhead genetics (full list in Appendix 1-A). I have read and fully considered these documents as a basis for answering the questions in the ToR.

The principal sources against which the format and content of the draft Recovery Plan have been assessed are the ESA and the Interim Endangered and Threatened Species Recovery Planning Guidance, Version 1.2 (NMFS, 2007). [NB: NMFS (2007) is a slightly modified version of the 2006 Guidance referred to in the ToR, but appears to be the only version readily available on the internet.] I have also obtained additional reference material from personal sources and the internet as required (see list of references cited in Appendix 1-B).

Although I have not undertaken a full check of the references in the Recovery Plan, I have found that a substantial number of the reports and papers cited in the text are not listed in the 'Literature Cited', and some references are ambiguous (e.g. three papers in the Literature Cited meet the description of 'Boughton *et al.*, 2007' but are not distinguished in the text in the conventional way). I have spent a significant amount of time, often fruitlessly, trying to identify and access references, and this has made it very difficult to evaluate fully some parts of the Recovery Plan.

**Modification to Schedule of Milestones and Deliverables:** The Schedule of Milestones and Deliverables (Appendix 2) requests the submission of the peer review report to the CIE by 31<sup>st</sup> July. This deadline was postponed to 10<sup>th</sup> August, in agreement between Cefas and CIE, because notification of the award on contract was not received until 9<sup>th</sup> July.

## **3. REVIEW OF INFORMATION USED IN THE RECOVERY PLAN**

An assessment has been requested of the information used in the Recovery Plan, as outlined in the table of contents. The plan should include and cite the best scientific and commercial information available on the species and its habitats (including threats to the species and large-scale perturbations such as climate change and ocean conditions). It should also take account of opposing scientific studies or theories. The following subsections are numbered according to the table of contents in the Recovery Plan ('RP-§X' refers to section X in the draft Recovery Plan).

## **RP-§1. INTRODUCTION**

NMFS (2007) suggests that this section of the Recovery Plan should now be referred to as “Background”. NMFS also suggests that, ‘Directly under the heading Background, the introductory paragraph should include a sentence about the general purpose of recovery plans’. This is not done in this Plan, although a short section entitled ‘What is a Recovery Plan?’ is included on p. xvi.

The subsequent sections have not been laid out quite as suggested by NMFS (2007), although they provide the general range of information that is proposed should be included in the Background, and the style of writing is suitable for reading by lay persons.

## **RP-§2. STEELHEAD BIOLOGY AND ECOLOGY**

This section provides a relatively short overview of taxonomy and life history of *O. mykiss* within the SCCC region. It also summarizes information on the species’ distribution, population structure, abundance, genetic structure and diversity and provides a brief introduction to the habitat characteristics of the SCCC area. Much of this information is expanded upon later in the Recovery Plan or is supplemented by the accompanying NMFS reports. As a result, while it would clearly be possible to provide a more comprehensive account of steelhead biology and habitat requirements, and particularly differences between the SCCC and other regions, this does not appear to be necessary here.

## **RP-§3. FACTORS LEADING TO FEDERAL LISTING**

This section provides a summary of the information provided to support the listing of SCCC steelhead as threatened under the ESA. Information is summarized for each of the five listing factors specified in the ESA, namely:

- A. Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range;
- B. Over-utilization for Commercial, Recreational, Scientific, or Educational Purposes;
- C. Disease and Predation;
- D. Inadequacy of Existing Regulatory Mechanisms; and,
- E. Other Natural or Human - Made Factors Affecting Continued Existence.

While this is a simply a summary of the more detailed information provided in the NMFS listing determinations, it is relevant to the Recovery Plan, because the ESA requires that in developing recovery plans for listed species, each of the factors which contributed to the species’ listing as threatened or endangered should be addressed in the recovery actions. This section therefore provides a suitable summary of the listing factors which should be cross-referenced against the recovery criteria later in the Plan.

## **RP-§4. CURRENT DPS-LEVEL THREATS ASSESSMENT**

The assessment of threats has been based upon the ‘Conservation Action Planning’ (CAP) process which is described in §4.1 and Appendix D. This process will be

discussed in more detail in the next section; some of the concerns expressed there reflect lack of clarity about the information used in the assessment.

It is difficult to identify the information that has been used in the development of the CAP Workbooks. Appendix D refers to work undertaken for NMFS by Hunt & Associates Biological Consulting Services (2008) (not referenced in the Recovery Plan) to update previous less complete assessments described in Kier Associates and National Marine Fisheries Service (2008). There are a number of discrepancies in the numbers of watersheds referred to in Appendix D. Kier Associates appear to have selected 22 coastal watersheds (although this is referenced as 23 watersheds in Appendix D, p.5, 1.41). Hunt & Associates extended this to 27 watershed encompassing 46 drainages (although this is referenced as 22 watersheds in Appendix D, p.2, 1.8). It is also unclear how many Workbooks were developed, because the text refers to 46 (Appendix D, p.2, 1.11) but only lists 22 in Table D-1.

It is unclear what data were used on stocks and stock status to support the ‘landscape-scale land use and habitat assessment’. For example, Appendix D indicates that the ‘conservation targets’ used for this CAP Workbook analysis were ‘*O. mykiss* life-history stages: egg, fry, smolt, and adult’ and ‘a more general conservation target, Multiple Life Stages, was also established’. However no further information is provided about the nature or level of these targets.

The CAP Workbook process also uses Key Ecological Attributes (KEAs) which are aspects of the conservation target’s biology or ecology such that if they were missing or severely degraded, it would result in loss of that target over time. The KEAs appear to address a very wide range of attributes and to feed directly into the identification of ‘stresses and sources of stress (threats)’, which are said to be ‘basically altered KEAs’. However, the documents do not list the KEAs nor the specific threats that have been identified.

Five broad categories of threats are considered in §4.2, but it is difficult to identify the specific nature or scale of some of these threats. For example, §4.2.2 addresses ‘agricultural, and urban development, roads and other passage barriers’ (which are themselves very distinct activities) and describes the extent of these land uses, but it provides little comment on the specific nature of the problems that they cause. This is unfortunate because it will clearly not be possible to remove agriculture or urban locations from the SCCC watersheds, but it may be possible to reduce or eliminate some of their impacts (e.g. pesticide application, fertilizer run-off, etc). NMFS (2007) (§5.1.6.7) notes the need to distinguish between the specific threats (e.g. sedimentation) and the sources of those threats (e.g. cattle watering), and this distinction requires clarification in this Recovery Plan.

Threats from non-native wildlife are considered in §4.2.4. Most of this section discusses stocking with anadromous and/or non-anadromous *O. mykiss*, but the extent to which such stocking is based on native or non-native broodstock is unclear. Reference is made to the CDFG’s Salmon and Steelhead Stock Management Policy which appears to provide guidance on stocking policy, but no citation is provided, and I was unable to follow up the source.

Environmental variability is considered in §4.2.5, with consideration being given to both temporal and spatial variation in environmental conditions and the additional effects that might arise from climate change. Given the extreme nature of the environmental conditions in many of the watersheds in the SCCC area and the potential short term impact of such variation on freshwater habitat and migration pathways, the report might usefully provide more information on key sources and impacts of such variation (although some information is provided elsewhere in the report).

Climate change is currently a very high profile topic, and there is much recent literature on the subject. Unfortunately, the majority of the references relating to climate change that are cited in the Recovery Plan are not listed in the Literature Cited (e.g. Backland *et al.* 2008; Bakke 2008; Bedsworth and Hanak 2008; Gutowski, *et al.* 2008; Hanak and Moreno 2008; Barbour and Kueppers 2008; Luers and Mastrandrea 2008; and Hanak and Lund 2008). It has thus not been possible to follow up these sources or assess whether they provide a comprehensive coverage of the current information on the potential effects of climate change. However, while various potential effects of climate change are listed, there is no specific consideration of likely climate change scenarios. Use of such scenarios is a common feature of much environmental planning and, while they may have considerable uncertainty, they can clearly be used to identify the areas where problems are most likely to occur or areas where most action may be required. Such scenarios have been developed for California (e.g. Cayan, *et al.* 2008), and it is surprising that they are not explicitly considered in the Recovery Plan.

#### **RP-§5. STEELHEAD RECOVERY GOALS, OBJECTIVES & CRITERIA**

This section presents NMFS's goal and objectives for the long-term persistence of viable, self-sustaining, harvestable, interacting wild populations of steelhead distributed across the DPS. It also describes the 'biological recovery criteria', at both population and DPS levels, and 'threats abatement criteria'. The development of the biological recovery criteria is addressed in much greater detail in the NMFS report by Boughton *et al.* (2007).

With respect to the information used in development of viability criteria in §5 and the supporting reports, it is clear that the authors have been severely constrained by the lack of historic monitoring data on stocks in the area. It is also recognized that this problem is exacerbated by the fact that the SCCC area is towards the southern edge of the steelhead range which results in some unusual features in the populations and their habitats which present particular challenges for sustainable management. However, viability criteria have been developed for a substantial number (nine?) DPSs of Pacific salmon and steelhead listed under the ESA. While it is clearly recognized that there may be a need to develop different viability criteria for different DPSs because of the different nature of the populations and their habitats, it is perhaps surprising that the Recovery Plan appears to acknowledges no consideration of reports and plans relating to these other DPSs ( e.g. Cooney *et al.*, 2007; McElhany *et al.*, 2006; Ruckelhaus *et al.*, 2002; Spence *et al.*, 2008; Wainwright *et al.*, 2007; Williams *et al.*, 2007).

It is also surprising that the Recovery Plan makes only passing reference to McElhany *et al.* (2000) which is an NMFS report specifically designed 'to provide an explicit framework for identifying attributes of viable salmonid populations so that parties may

assess the effects of management and conservation actions and ensure that their actions promote the listed species' survival and recovery'. This report identifies four parameters that 'form the key to evaluating population viability status'; these are abundance, population growth rate, population spatial structure and diversity. This is a very useful working structure, and McElhany *et al.* (2000) provide further guidance on aspects of viability, extinction risk, etc which do not appear to be taken up in this Recovery Plan. Further discussion of the specific viability criteria is provided in the following section.

The proposals for the threats abatement criteria are based upon a sensible ranking system, but as with the description of the threats themselves (see above) there is little explanation of how the ranking has been determined. Since the threats are very general and mainly relate to threat sources (e.g. urban development) it is unclear what information the ranking is based on and it is difficult to determine whether that information is comprehensive or appropriate. Thus for example, urban development has been ranked "1B" indicating that it is associated with high-priority recovery actions which address listing factors B to E; it seems very surprising that this threat is not ranked 1A, since various aspects of urban development clearly appear to result in the "destruction, modification or curtailment of habitat" (e.g. loss of estuarine habitat). The ranking of these recovery actions has direct implications for the subsequent sections of the Recovery Plan, particularly §8-§11 which address the recovery actions for each BPG. More information is therefore required to support this section.

#### ***RP-§6. STEELHEAD RECOVERY STRATEGY***

The development of the recovery strategy for SCCC steelhead is based around the identification of tiers of populations, referred to as Core 1, Core 2 and Core 3. Table 6-1 in the Recovery Plan provides the preliminary designation of SCCC steelhead populations to these tiers. This is based in part on Broughton *et al.* (2006) which provides an extensive analysis of the potential viability and independence of each of the steelhead populations in the SCCC area. However the Core rankings do not match the rankings in other analyses and so it is unclear how the final assignation of ranks has been determined. This needs to be clarified.

#### ***RP- §7. SUMMARY OF DPS-WIDE RECOVERY ACTIONS and RP-§8 to§11 relating to each BIOGEOGRAPHIC POPULATION GROUP***

In terms of the information used, all the sections concerning DPS-wide and BPG specific recovery actions suffer from the lack of clarity concerning the determination and prioritization of threats discussed above. This introduces uncertainty both about the specific problems that need to be addressed and the prioritization of the recovery actions. This needs to be clarified.

#### ***RP-§12. SOUTH-CENTRAL CALIFORNIA STEELHEAD MONITORING, RESEARCH AND ADAPTIVE MANAGEMENT***

This section provides an overview of some of the science supporting the Recovery Plan, identifying specific gaps in knowledge which are then addressed in outline research proposals. In terms of information used, the basis for these proposals is reasonably well

justified, although it is assumed that a full submission for research funding might be expected to provide a more detailed review of background information.

The section on adaptive management refers to a Panel on Adaptive Management for Resource Stewardship 2004, but no reference is provided, and I was unable to source any information on it. Furthermore, most of the other references cited in this section, e.g. Thomas *et al.*, 2001; Baxter *et al.*, 2006, Wilson, 2003; Karieva *et al.*, 2000; Kroon *et al.* 2000; Fujiwara, 2007; Hodgson and Townley, 2004, appear to have been omitted from the Literature Cited and could not be sourced. This has made it virtually impossible to assess the extent of the information used to support this section.

### **RP-§13. IMPLEMENTATION BY NMFS**

This section addresses the requirements of the ESA and the requirements of NMFS (2007) which are appropriately utilized.

## **4. REVIEW OF THE FINDINGS MADE IN THE RECOVERY PLAN**

### **4.1 DPS considerations: Populations, Habitats and Threats**

#### **4.1.1 Populations**

The Recovery Plan and supporting reports emphasise that there is a dearth of good historic information on the majority of steelhead populations in the SCC area. Key aspects of the analysis of information relating to the steelhead populations are discussed below.

*Species description and taxonomy:* NMFS (2007) requires the inclusion in the recovery plan of an overview of the species and a description of its taxonomy and physical appearance, written approximately on the level of a field guide. This is satisfactorily addressed in §2.1 of the Recovery Plan, which usefully relates the description to the recovery objectives.

*Population distribution and abundance:* Estimation of historic and current population distribution and abundance is clearly critical to the development of recovery plans and forecasting future trends but is constrained by the lack of data on many populations. The Recovery Plan provides a good summary of the available data, indicting the efforts made in the past decade to survey populations in the area. Information on the distribution of steelhead is obviously much more complete and reliable than the estimates of abundance, but there are even uncertainties about whether steelhead were historically or are currently present in some streams. Nevertheless the Recovery Plan provides a reasonable assessment and overview of the available information

*Population growth rate:* The population growth rate or productivity is central to a population's viability because it indicates how well a population is performing in the habitats it occupies during its life cycle (McElhany *et al.*, 2000). It is therefore a major determinant of the population's dynamics and thus also its abundance. The importance of growth rate is acknowledged in the Recovery Plan, for example in relation to the

effects of ocean conditions, and it is noted that it can fluctuate irrespective of population size. The importance of enhancing population growth rates is also addressed in relation to the development of critical recovery actions and particularly the restoration of access to historic habitats. Furthermore, the Plan suggests that ‘a useful common currency for comparing recovery actions is their cost-efficiency with respect to growth rate’, expressed as the improvement in growth rate per unit of recovery expenditure.

However, despite the clear recognition of the value and importance of population growth rate this is not considered as one of the viability criteria, and no mention is made of it in relation to future monitoring plans.

*Population diversity:* Salmonid populations can show considerable diversity both within and between populations and this is likely to be particularly significant for populations of *O. mykiss* towards the edge of their range in the SCCC area. It is therefore very appropriate that the Recovery Plan recognises the importance of genetic structure and diversity and addresses it within one of the recovery objectives. The most obvious source of diversity is between resident, anadromous and other intermediate (e.g. adfluvial) life-history variants. However additional traits that may vary in response to particular environmental pressures on the populations may include morphology, fecundity, run timing, spawn timing, juvenile behaviour, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behaviour, etc.

The Recovery Plan provides a summary of genetic studies that have been undertaken on a limited number of *O. mykiss* populations in recent years. However, these studies do not resolve many of the outstanding issues, particularly relating to the relationship between resident and anadromous *O. mykiss* populations. This is unfortunate, not least because of the potential critical nature of such relationships, as recognised in the plan. However, there appears to be increasing evidence that such relationships may vary significantly between regions and even populations (McPhee *et al.* 2008, Quinn and Myers, 2004).

*Population spatial structure:* Spatial structure within a population or group of populations is critical to the assessment of viability because it affects population dynamics and hence extinction risks in ways that may not be easily recognised from simple monitoring of abundance and productivity. Given the extreme nature of the environmental conditions in some of the SCCC watersheds (e.g. sections of river drying up for part of the year) and the consequent problems for habitat connectivity, it is clear that the effects on population structuring might be particularly acute. The spatial structure of a population will clearly be affected by the quality and spatial distribution of habitat features and so will be intimately linked to the efforts to habitat restoration efforts.

*Biogeographic Population Groups (BPGs):* The Recovery Plan proposes dividing the steelhead populations within the SCCC DPS into four Biogeographic Population Groups (BPGs), which appear to conform to the principle of Recovery Units as described by NMFS (2007) although they are not referred to as such. The plan provides a brief overview of the rationale for the BPGs which is supported by data in some of the other NMFS reports, principally Boughton *et al.* (2007). [NB: The caption to Table 2.2, which defines the biological characteristics of the BPGs, refers to Table 4 in Boughton *et al*

(2007), but this should be Table 5.] The classification is based on two simple rules: populations were sorted into a coastal super-group and an inland super-group, and within these, they were sorted into groups defined by contiguous areas with broadly similar physical geography and hydrology. This has provided a logical and supportable set of four BPGs which satisfies the requirements of representation of all diversity groups, and sufficient redundancy to protect against future catastrophes.

#### **4.1.2 Habitats**

Key requirements for all salmonids are the availability of habitat for different life stages (e.g. spawning areas suitable for egg deposition and good embryo survival, fry and parr rearing areas, and holding areas for returning adults) and appropriate spatial and temporal connectivity between these areas. This is recognised in the Recovery Plan with the designation in §1.3 of habitat features which are referred to as ‘primary constituent elements’ (PCEs), although no further mention is made of these PCEs in the plan. This is surprising since use of this structure might have clarified the description of habitat characteristics in §2.5 and more particularly the identification of threats in §4 and recovery actions in subsequent sections.

#### **4.1.3 Threats**

The assessment of threats has been based upon the ‘Conservation Action Planning’ (CAP) process, an approach developed by The Nature Conservancy (TNT) as an integrated process for planning, implementing, and measuring conservation success for its conservation projects. I have not used the CAP Workbook process and so the following comments are provided from a similar viewpoint to other readers who may be unfamiliar with the approach.

It is apparent that the CAP process has been used in a range of projects in different parts of the world, but it is not clear whether there has been any review of its application or comparison with other approaches; the information used to support the use of this approach in the RP is largely taken from TNT (or similar) material (e.g. [http://conserveonline.org/\\_workspaces/cbdgateway/cap/index.html](http://conserveonline.org/_workspaces/cbdgateway/cap/index.html).) Use of this type of approach conforms to the NMSF (2007) strong recommendation to undertake a structured threats assessment for the species.

The threat assessment procedure, which is just one of 10 steps in the full CAP process, is based upon the development of CAP Workbooks for each of the watersheds. The process is outlined briefly in §4.1 of the Recovery Plan, and the methods are presented in a little more detail in Appendix D. It is asserted that the method provides an ‘objective, consistent tool’, which allows for the incorporation of both quantitative and qualitative (e.g. professional judgment) measures of existing habitat conditions. While there appears to be some contradiction between the claim for objectivity and the use of subjective information such as professional judgment, it is apparent that this is a tested and reasonably widely used approach. The Workbooks also have the advantage of being easily updated as new information is provided. Nevertheless, it would be helpful to have greater clarity about the actual threat selection and prioritisation process, rather than presenting it as a ‘black box’.

Issues concerning the unclear explanation of the nature and extent of the KEAs and specific threats have been discussed above; this lack of clarity also makes it difficult to evaluate their application in the Recovery Plan. There is also some confusion about how specific issues are addressed within the threat assessment. Thus for example, non-native predators are considered in §4.2.1 under the heading of ‘dams, surface water diversion and ground water extraction’, but ‘non-native wildlife’ is also discussed in §4.2.4. This latter section mainly addresses stocking with steelhead, which might presumably include use of native broodstock. Similarly, the loss of important estuary habitat is discussed in §4.2.2 under the heading of ‘agricultural, and urban development, roads and other passage barriers’. As a result there are a variety of ways in which the information provided is unclear. In general it would be much clearer if this section was structured around the threats and not the sources of threats.

Having identified KEAs for each target, ‘measurable indicators’ (e.g. water temp, turbidity, etc) were identified to characterise existing conditions in watersheds. These indicators are not provided in the plan but are said to be listed in Kier Associates and National Marine Fisheries Service (2008). However, I could not access this report. These indicators are assigned values from ‘poor’ to ‘very good’, which are then entered into the CAP Workbooks. The process for making this assignment is not at all clear, nor is the process by which the Workbook automatically combines these values to provide an overall assessment. For example, while it is noted that gaps can be filled at a later date and the Workbooks updated, it is not clear how gaps are handled in the assessment.

It would therefore be helpful to have further explanation of the threat assessment process, what specific threats were identified and how they were assigned values. The current lack of clarity compounds the uncertainties in the final assessment of threats which will be discussed in a later section.

As indicated above, more information could usefully be supplied on predicted climate change scenarios (e.g. as provided by Cayan *et al.*, 2008) in order to focus recovery activities more precisely.

Finally NMFS (2007) indicates that this section of the Recovery Plan should address all the threats listed in the final rule and discussed in terms of the five listing factors. In this context, the Plan indicates that the California Department of Fish and Game (CDFG) continues to allow some summer trout fishing in significant parts of the Salinas River system with minimum size bag limits, and a few other creeks have summer catch-and-release regulations. Various studies have shown that post-release mortalities of fish can be high when water temperatures increase and so the suggestion that has resulted in minimal or no mortality to *O. mykiss* seems surprising. No indication is given as to whether these activities should or will be permitted to continue, and it is not clear whether this was considered as a threat.

## **4.2 Extinction Risk Analysis and Recovery Criteria**

### **4.2.1 Extinction risk analysis**

The extinction risk analysis provides the basis for setting the population-level recovery criterion P1 for mean annual run size (see below). This analysis is not explained in the Recovery Plan but is addressed by Boughton *et al.* (2007), who have applied a relatively simple extinction model from Lande (1993) and Foley (1994). The model estimates the expected time to extinction,  $T_e$ , by diffusion analysis of the log population size  $n_t$  ( $= \log_e N_t$ ). The model population grows according to the equation  $n_{t+1} = r_t + n_t$ , with  $K$ , the carrying capacity, as a ceiling and  $r_t$  being the expected change in  $n_t$  (i.e. the log of the population growth rate). Application of the model therefore requires estimation of  $r_t$  and  $V_r$ , the variance of random variation in  $r_t$ , which expresses the environmental stochasticity. In principle, these values should be readily calculable from a reasonable time series of population census data, but such information has only been collected for one SCCC steelhead population (above San Clemente Dam on the Carmel River) and Boughton *et al.* (2007) express legitimate concerns about the use of these data. They are therefore left with having ‘to speculate about a cautiously optimistic standard for  $r$  in habitat of moderately good quality’, proposing a value of 10% per year. While this may be a reasonable ‘guess’, this is clearly a critical parameter affecting the extinction dynamics and it would be appropriate to provide some clearer justification for the choice.

There are also no data on values of  $V_r$  for SCCC steelhead populations. For this parameter, Boughton *et al.* (2007) have obtained estimates for 20 populations of chinook salmon and one population of steelhead from the Central Valley; little information is available on the sources of these data, which is unfortunate since the estimates of  $V_r$  range over nearly an order of magnitude. Nevertheless, Boughton *et al.* have assumed that each SCCC steelhead population has a  $V_r$  randomly drawn from an underlying distribution describing all the Central Valley populations.

Applying the above values in the extinction model leads to the conclusion that it is necessary to maintain a mean run size of at least 4,150 spawners per year (S) in order to achieve 95% chance of persistence for 100 yr in the SCCC steelhead populations. However, this value is not only very strongly affected by a small change in the performance standard chosen (e.g. using a 94% or 96% standard instead on 95%), but is also extremely sensitive to the values of  $r$  and  $V_r$ . Given the great uncertainty in these parameters, the resulting ‘spawner rule’ must be regarded as highly speculative, and it seems very questionable whether there is any value in using this specific value at this stage. This is discussed further in relation to recovery criterion P1, mean annual run size.

### **4.2.2 Recovery criteria**

The Recovery Plan describes two types of recovery criteria, ‘biological recovery criteria’ (§5.3), at both population and DPS levels, and ‘threats abatement criteria’ (§5.4). This addresses the requirement of NMFS (2007) that the recovery criteria should not only include measures such as population abundance and growth but should also ensure that the underlying causes of decline (i.e. the threats) have been addressed and mitigated.

## **Biological Recovery Criteria:**

The Recovery Plan identifies four ‘biological recovery criteria’ at the population level (P1 - mean annual run size, P2 - ocean conditions, P3 - spawner density and P4 - anadromous fraction) and two at the DPS level (D1 - biogeographic diversity and D2 - life-history diversity), and these are described in much greater detail in Boughton *et al.* (2007). The following section assesses these in relation to the specific requirements of NMFS (2007).

*P1. Mean annual run size:* It is clearly appropriate to consider mean annual run size as a recovery criterion because small populations face a range of risks as a direct consequence of their low abundance and large populations exhibit a greater degree of resilience. It therefore addresses the need to ensure population ‘resiliency’ (NMFS 2007) which involves ensuring that each population is sufficiently large to withstand stochastic events. The Recovery Plan suggests using a critical threshold for run size which is akin to the first guideline for a ‘viable population size’ proposed by McElhany *et al.* (2000), namely that, ‘a population should be large enough to have a high probability of surviving environmental variation of the patterns and magnitudes observed in the past and expected in the future.’ This value is therefore derived from the extinction analysis discussed above, and purports to be the run size that is sufficient to result in an extinction risk of <5% within 100 yrs.

However, as discussed above, the ‘4,150 spawner rule’ derived from the extinction analysis is very sensitive to the values of two parameters which are themselves very uncertain. Furthermore, Boughton *et al.* (2007) acknowledge that the Big Sur Coast has numerous small coastal basins containing steelhead populations that appear to have very low background extinction rates, and yet appear to have average run sizes well below 4,150. Thus, while the spawner rule may be appropriate for some of the larger watershed, it seems questionable whether the value is very much better than an educated guess. It is also notable that applying this run size to the 36 watershed in which steelhead were known to have occurred historically would give a total run size over five times the historic run estimate of 27,000 reported elsewhere in the Recovery Plan.

The suggestion is made that this spawner rule could be applied as a precautionary approach, pending the collection of sufficient data from local populations to refine it. However, if the value is strongly suspected to be unrealistic for many populations, it appears questionable whether it is appropriate to use it at all before a more reliable value is available because of the risk that it may result in recovery activities being inappropriately planned or prioritised.

*P2. Ocean condition:* The Recovery Plan notes that ocean survival of steelhead is believed to be connected with variations in marine conditions, which may undergo cyclical changes (e.g. poor condition may last for two decades). As a result there is a need to ensure that population abundance is sufficient to secure the population against fluctuations in growth rates during these poor periods. The Recovery Plan therefore suggests that the mean annual run size criterion should apply under all oceanic conditions. However, it is questionable whether this should be treated as a separate recovery criterion in its own right because it is essentially just a special qualification imposed on the first criterion.

The Recovery Plan suggests that this criterion could be shown to have been met in one of two ways: monitor population size for at least the duration of the longest-period climate “cycle”, which it is suggested could be about 60 years; or concurrently monitor population size and ocean survival, so that periods of low ocean survival can be empirically determined. The first approach appears unsuitable because it would effectively result in the determination of recovery not being possible for a very long time regardless of the actual condition of individual populations. This could result in recovery activities being badly or inappropriately prioritised for extended periods.

The second approach could be applied, and the Recovery Plan correctly notes the importance of monitoring both smolt and adult numbers in some watersheds in order to be able to separate the effects on population growth rate of changes in freshwater conditions from the effects of marine conditions. However, a further complicating factor is the potential effect of environmental conditions experienced by the fish during the freshwater phase on their subsequent ocean survival; there is good evidence of this occurring for a number of salmonid species, and the effects of lagoon growth is a clear example of such an effect in steelhead (Hayes *et al.*, 2008).

Given the uncertainty about this criterion, it is not clear that it satisfies the ESA requirement for objectivity and measurability.

*P3. Spawner density:* This criterion reflects the fact that the value of achieving a specific mean annual run size may be limited if those fish are too widely dispersed within the river. While this is a legitimate concern, there is currently insufficient knowledge about the dispersion of steelhead spawners within watersheds to propose a suitable viability threshold. The Recovery Plan therefore proposes that such values should be established by undertaking research. It is unclear how quickly this could be achieved, and as a result this criterion appears to fall short of the ESA requirement for both objectivity and measurability.

*P4. Anadromous fraction:* The inclusion of anadromous fraction as one of the recovery criteria appears, at first sight, to be highly appropriate, given the importance placed upon the maintenance of population diversity. For example, Good *et al.* (2005) note that although the relationship between anadromous and resident *O. mykiss* in this ESU is poorly understood, it was thought to play an important role in its population dynamics and evolutionary potential, and other NMFS reports highlight the potential importance of the interplay between different life-history strategies. However, this recovery criterion is, once again, just a special condition placed upon the criterion P1 (i.e. it is proposed that the threshold level for mean annual run size should be made up entirely of anadromous fish) and it does not appear necessary or helpful to include it as a separate recovery criterion.

Since the listing is based only on anadromous *O. mykiss* it is not unreasonable to ensure that numbers of spawning steelhead (i.e. excluding resident fish) exceed an appropriate viability threshold. This is an appropriate precautionary approach as long as it does not have negative effects on efforts to promote diversity.

Boughton *et al.* (2007) also note the potential negative effects of hatchery fish on the population viability, but this is not included as a criterion in its own right or a condition upon criterion P1. It would be appropriate to consider listing all such factors as qualifying conditions to criterion P1.

*D1. Biogeographic diversity:* This criterion indicates the minimum number of viable populations that there should be in each of the four BPGs and specifies certain requirements of those populations. This addresses some of the requirements for ‘redundancy’ (NMFS, 2007) which involves ensuring a sufficient number of populations to provide a margin of safety for the species to withstand catastrophic events.

The basis for selecting the number of viable populations required to satisfy this criterion is not explained in the Recovery Plan but is addressed by Boughton *et al.* (2007). They indicate that the three most prominent natural disturbances that appear to pose a risk to entire populations are wildfires, droughts and debris flow. They propose that the required number of viable populations and their separation be estimated on the basis of the incidence and size of wildfires because this will tend to be more conservative than a level based on debris flows, and droughts tend to affect too large a geographic area to be useful. Boughton *et al.* (2007) acknowledge that the specific criteria determining the sufficient number of viable populations may be viewed as very conservative because they call for a <1% risk in 1000yrs and assume that all wildfires down to 1 km<sup>2</sup> have catastrophic effects on steelhead populations. But they counter this by suggesting that this conservatism balances the apparent increase in size and frequency of wildfires that has been observed in recent years.

It appears that there may be a basis for fine-tuning this criterion somewhat by more precisely assessing such features as the scale of wildfires that might be expected to have catastrophic effects and the current trends in wildfire incidence. In addition more information should be copied across into the Recovery Plan to explain the rationale behind the selection of this criterion.

*D2. Life-history diversity:* The Recovery Plan clearly recognises the importance of genetic structure and diversity within and between populations of *O. mykiss*. This is partially reflected by the recovery criterion, which requires the viable populations to exhibit all three life-history types of fluvial-anadromous, lagoon-anadromous and freshwater resident). Maintaining such diversity within the DPS is appropriate and important, but it is unclear how this criterion will be applied at the population level and how it will satisfy the need for ‘representation’ (NMFS (2007) which requires conserving the breadth of the genetic makeup of the species to conserve its adaptive capabilities. For example, it is unclear how many individuals would need to be observed over what time-frame to satisfy the need to ‘exhibit a life-history type’. This criterion therefore needs clarification.

#### **Threats abatement criteria (§5.4):**

NMFS (2007) proposes that the Recovery Plan should establish criteria for each of the listing/delisting factors that are currently relevant to the species in order that it is more likely to ensure that the underlying causes of decline have been addressed and mitigated. In §3, the Recovery Plan indicates that all of the listing factors except Factor C (Diseases

and predation) have probably contributed to the decline of steelhead, although the effects of Factor B (Over-utilisation) has been greatly curtailed in recent years. The Recovery Plan proposes that all recovery actions be given a priority from 1 to 3, in accordance with the principles set out in NMFS (2007) and also ranked according to whether they address the first listing factor (A) or one of the other listing factors (B). The threats abatement criteria then require threats in the different categories to be reduced by specific steps (e.g. from ‘high’ to ‘medium’, or ‘medium’ to ‘low’.)

In principle this approach looks sound but the difficulty of determining the objectivity of the threats assessment (discussed above), means that it is difficult to determine how objectively these threat abatement criteria can be applied. In addition, the threat abatement criteria are not clearly related to the listing factors. Thus, for example it is not clear that issues relating to Factor D (Inadequacy of existing regulatory mechanisms) is adequately addressed; as elsewhere in the Plan, this could be clarified by structuring the actions around the listing Factors. Finally, the threat levels are not clearly explained in the Plan and so it is unclear how changes will be assessed.

The Recovery Plan also identifies the following five additional threat abatement criteria:

- Viable populations have unimpeded access to previously occupied habitats;
- Freshwater migration corridors supporting viable populations meet the life history and habitat requirements of steelhead;
- Watersheds supporting viable populations have habitat conditions and characteristics that support all life-history stages;
- Adequate funding, staffing, and training are provided to state and federal regulatory agencies to ensure the ecosystem and species protections of state and federal requirements are properly implemented;
- Standardized monitoring of populations and their habitats in each BPG across the DPS evaluates the effectiveness of recovery actions and measures progress towards recovery.

While these are laudable aims it is unclear how they will be applied in an ‘objective and measurable’ manner as required by NMFS (2007).

#### **Additional requirements of recovery criteria:**

NMFS (2007) specifies a number of additional requirements for recovery criteria. The first is that they need to be established for each recovery objective. The Recovery Plan identifies the following six recovery objectives (in italics), and I have indicated against each whether it appears to be addressed by the recovery criteria:

1. *Prevent steelhead extinction by protecting existing populations and their habitats – with particular emphasis on protecting the few extant inland populations;*  
It is not clear how the recovery criteria will ensure that particular emphasis will be placed on protecting the few extant inland populations;
2. *Maintain current distribution of steelhead and restore distribution to previously occupied areas;*

The recovery criteria do not appear to ensure that the current distribution of steelhead is maintained or that steelhead are restored to previously occupied areas because they only appear to apply to selected populations:

3. *Increase abundance of steelhead to viable population levels, including the expression of all life history forms and strategies;*  
This is only addressed for the specified number of viable populations;
4. *Conserve existing genetic diversity and provide opportunities for interchange of genetic material between and within viable populations;*  
This is only marginally addressed by the recovery criterion D2-life-history diversity;
5. *Maintain and restore suitable habitat conditions and characteristics to support all life history stages of viable populations; and*  
This is not specifically addressed by any of the recovery criteria, but may be considered to be inferred where viable populations are maintained.
6. *Conduct research and monitoring necessary to refine and demonstrate attainment of recovery criteria.*  
This is not addressed in the recovery criteria, although it is not clear that this is necessary.

NMFS (2007) also notes the importance that the recovery criteria should be SMART (i.e. Specific, measurable, achievable, realistic and time-referenced). Unfortunately the difficulties discussed above means that this is generally not the case for most of the criteria proposed.

NMFS (2007) notes that, ‘in some rare cases, the current best available information is so seriously limited that it is truly not possible to identify delisting or reclassification criteria.’. In such cases, it may be appropriate to (1) describe interim objectives and criteria, which will be used for the short-term until better delisting objectives and criteria can be determined; (2) explain clearly in the plan and the administrative record why objectives and criteria are undeterminable at the time; and (3) include the actions necessary and timelines in the plan to obtain the pertinent information and develop recovery objectives and criteria once the information is obtained’. It appears that such an approach would be appropriate for some or all recovery criteria in this Recovery Plan. The plan already indicates that some of the recovery criteria will need to be quantified or improved by means of further research. However this does not satisfy the requirements above since interim objectives and criteria have not been specified and neither have any timelines been provided.

## **4.3 Evaluation of Conservation Measures**

### **4.3.1 Recovery strategy**

The development of the recovery strategy for SCCC steelhead is based around the identification of tiers of populations, referred to as Core 1, Core 2 and Core 3. The Recovery Plan states that the Core 1 populations form the nucleus of the recovery strategy and must meet the population level biological recovery criteria; it is therefore

proposed that these populations should be the first focus of an overall recovery effort. However, this appears to be at odds with the description of the Biological Recovery Criteria (e.g. Table 5-1) which appear only to ‘apply to the [13] populations selected to meet DPS-level criterion D.1.1’. This confusion is further compounded by the suggestion that the Core 2 populations also form part of the recovery strategy by contributing to the set of populations necessary to achieve recovery criteria such as minimum numbers of viable populations needed within a BPG. This requires clarification.

#### **4.3.2 Recovery actions**

The various sections in the Recovery Plan describing recovery actions are confusing and unclear. An initial section (§6.2) identifies ‘impassable barriers’ and ‘water storage and withdrawal’ as the developments or activities posing the principal threats to the species. While this assessment is intuitively sound, it is not clear whether it is based on a specific threat assessment, and if so how.

The Plan then lists (Table 6-2) a number of ‘critical recovery actions’ relating to nine rivers in the SCCC area to address these two threats. For each of these rivers it identifies one or more dam that needs to be modified or removed, and for some rivers it identifies the need to implement revised flow management schemes. However, it is not clear how these problems were identified or prioritized. For each river Table 6-2 also identifies the need to ‘identify, protect and where necessary restore estuarine and freshwater habitat’. This does not appear to be related to the two principal threats and is such a generic action that it is not informative.

A subsequent section (§6.3), summarises the ecological rationale for regarding the restoration of steelhead access to historic habitats that are currently inaccessible and unoccupied by the species as an ‘essential action’. This rationale is sound, but given the large number of such barriers that appears to exist in the SCCC area, it would be helpful to consider ways to prioritise both complete and partial obstructions according to their potential effects on a population, for example by estimating the amount of production that is lost. It is important to note that a partial barrier to a large production area may be as damaging as a complete barrier to a small production area but may be a lot cheaper to rectify, giving much greater benefit/cost. It’s not clear why this section only considers the ecological rationale for classing barriers as a critical and not the rationale behind identifying flow management regimes.

§7 addresses DPS-wide recovery actions and §7.1 lists a wide range of activities from management of the recovery program itself (e.g. prioritizing restoration funds), to collaborative activities (e.g. engaging with partners and stakeholders), and active removal of threats (e.g. modifying passage barriers). All the actions address legitimate concerns and can reasonably be considered on a DPS scale because they are likely to apply to a number (or all) watersheds. However, the list is not structured very logically and there is no indication of prioritization or who would be responsible for each action. These concerns are partially addressed in Table 7-1, which groups the recovery actions in relation to different threat sources, but as indicated above (and by NMFS, 2007) it would be helpful to distinguish between the source of the threat and the threat itself.

The recovery actions for each of the four BPGs are described in §8 to §11. These sections provide an overview of each BPG region, the main land-use and population features and the current watershed features. They also provide a sub-section on ‘threats and threat sources’ although as indicated elsewhere these are principally threat sources and not the threats themselves, which would be more useful. The section also lists the ‘ten anthropogenic activities ranked as the top five sources of stress to anadromous *O. mykiss*'; it is not at all clear what this means or how this list is generated. The summary to each of these sections (§8.5, §9.5, etc) and the accompanying tables identify actions to address threats in the main watersheds or sub-watersheds. However, the link between this and the threat assessment earlier in the Recovery Plan is very difficult to see, not least because of the problems with the threat assessment discussed above. In addition, the proposals include very comprehensive lists of actions, but it is not clear whether all these activities are required to restore the population to a satisfactory level or whether there is scope for prioritizing the actions, possibly on the basis of a benefit/cost analysis. The tables also address barriers and flow management in many watersheds, and include the critical actions identified in §6. It is therefore very unclear how these actions would be managed at these different levels (i.e. critical actions, DPS-actions and BGP/watershed actions).

Pursuant to Section 4(f) of the ESA, Recovery Plans are required to include estimates of the time and cost to carry out the recommended recovery measures. No timescales or costs are provided for any of the DPS-wide recovery actions listed in §7.1. In addition, although the tables in §8 to §11 provides spaces to insert ‘task duration’ and ‘fiscal year costs’, no data have been included. Appendix F provides a very comprehensive list of the costs of various habitat improvement activities undertaken on a range of watersheds and which may be relevant to this Recovery Plan. These are grouped under various headings (e.g. fish ladders, instream habitat restoration, etc) and indicate the location, date and rough extent of the work undertaken, plus the total or unit cost. This information is a useful first step towards assessing the likely costs of the recovery activities, but it requires further analysis or explanation before it can be applied usefully to estimating costs of many of the proposed actions. For example, there is a need to try to account for the wide range of costs for each activity (e.g. spawning gravel supplementation ranges from \$11/cy to \$72/cy) in order that it can be used in making sensible cost forecasts for identified projects. The Recovery Plan therefore appears to fall well short of what appears to be required under the terms of the ESA in relation to the provision of estimates of the time and cost to carry out the recommended recovery measures.

#### **4.4 Research and Monitoring Recommendations**

NMFS (2007) states that research actions in the recovery program section of the plan should be limited to those essential to meeting recovery criteria and achieving goals of the plan. This presents some difficulties because of the problem with the selection of recovery criteria discussed above; and even if the recovery criteria are adopted, they require significant research to be reliably quantified.

The Recovery Plan identifies ‘critical research needs for recovery’ in §6.4 and then provides a more detailed description of 12 potential research topics in §12.3. (It’s not clear why §6.4 is required and what it adds.) The questions posed in relation to each

topic are generally important issues that would improve understanding of steelhead in the SCCC area, in particular relating to the habitat requirements of different steelhead life-stages (e.g. nursery habitat and migration corridors), ecological factors affecting anadromy, the unusual features of watersheds in the SCCC area (e.g. estuarine lagoons and intermittent creeks), population structuring and the potential effects of climatic change. The diversity of the topics identified clearly reflects the paucity of currently available information on these steelhead populations.

There is a degree of overlap between the proposals which could usefully be clarified to avoid duplication. For example, the first proposal on ‘ecological factors that promote anadromy’ appears to be duplicated in the proposals relating to the ‘reliability of migration corridors’ and ‘steelhead-promoting nursery habitats’. Similarly there appears to be overlap between the proposals relating to ‘uncertainty about population structure’, ‘partial migration and life-history crossovers’ and ‘rates of watershed exchange’.

Three proposals specifically address the recovery criteria relating to mean run size, spawner density and natural catastrophic events. However the information for the first of these appears to be derived from other monitoring or research activities (i.e. proposals 12.3.10 and 12.3.11) and so it is unclear what the research would address.

These points could usefully be clarified, but overall it appears that the proposed research will support the planning of suitable recovery actions to increase the chance of ensuring the restoration of the SCCC Steelhead DPS. It is important to note that the proposed monitoring activities are certainly as important as the research, and may be more important, for both establishing the recovery criteria and determining recovery. It is also clear that there should be close coordination between the research and monitoring activities, because counting stations and life-cycle monitoring stations will provide important facilities and support for research activities.

A number of the research activities are aimed at identifying factors (e.g. migration pathways or nursery habitat) which promote the production on anadromous *O. mykiss*. There is some indication (although this may be reading between the lines) that this might lead to the manipulation of habitat to benefit steelhead, to the possible detriment of other life-history forms and possible undesirable effects on diversity. This must be addressed with great caution.

### **Other research:**

One of the problems with conducting research on endangered or threatened populations is the risk of doing additional harm to a population. This may be a problem when stocks are monitored or surveyed because trapping and handling may affect fish behaviour or survival, particularly where it is practiced in harsh environments (e.g. high water temperatures). Consideration could be given to making use of or commissioning research on populations that are not threatened, possibly in other areas, wherever possible.

Specific problems are noted in the Recovery Plan with the use of experimental techniques which require lethal sampling, such as otolith analysis. There is therefore a

need to investigate alternative, non-lethal methods, such as scale analysis, or possibly analysis of other tissues.

## 5. SUMMARY OF FINDINGS

The following are my principal findings from the preceding sections:

- There are significant shortcomings in the citation of reference material in the Recovery Plan;
- The structure and format of the Recovery Plan does not conform closely to the Interim Endangered and Threatened Species Recovery Planning Guidance (NMFS (2007). The ToR refer to the 2006 Guidance and it is not clear how this has been updated, but it would seem appropriate to use the latest Guidance document (particularly as this is already two years old).
- While the threats assessment appears to be based on a tested method, the process by which threats have been identified and prioritized is not clearly explained or presented in the Recovery Plan. As a result, although the conclusions appear generally reasonable, the reader cannot make an objective evaluation of the process by which they were derived.
- In several sections, the Plan does not distinguish clearly between the threats and the source of those threats; in addition in several sections, the threats are not logically structured and not related to key headings such as the listing Factors or the recovery objectives.
- The threats are not clearly prioritised and so do not provide a clear mechanism for prioritising recovery actions.
- There are major uncertainties about the recovery criteria for the SCCC Steelhead DPS, principally because of the paucity of historic data. Thus one of the principle biological criteria (mean run size) provides an extremely uncertain, and for some watershed unrealistic, threshold level. At least two of the other criteria (oceanic conditions and anadromous fraction) simply place special conditions on the mean run size criterion and several cannot be precisely quantified at this stage.
- Consideration should therefore be given to describing interim objectives and criteria, which will be used for the short-term until better delisting objectives and criteria can be determined; the reasons would need to be explained in the Plan along with the actions necessary and timelines in the plan to obtain the pertinent information and develop recovery objectives and criteria once the information is obtained.
- The process for operating threat abatement criteria (RP-§5.4) based on a ranking system appears generally sound, but it is complicated by the lack of clarity on the way the threats themselves are defined and prioritized (i.e. the allocation of levels). The five additional threat abatement criteria address important issues, but it is unclear how they will be applied in an objective and measurable way.

- Overall the recovery criteria do not clearly address the recovery objectives stated in the Recovery Plan and cannot generally be regarded as ‘SMART’. As a result the criteria generally fail to satisfy the requirements of NMFS (2007) and the ESA.
- The recovery actions are not logically or clearly presented and this confusion is increased by presenting critical actions, DPS-level actions and BGP level actions, many of which overlap. This problem partly arises from the lack of clarity over identification and categorisation of the threats and sources of threats mentioned above. The recovery actions do not identify the responsible parties, costs or timescales and so do not meet the requirements of the ESA.
- The outline research proposals address issues that are pertinent to the recovery of the SCCC Steelhead DPS. However, there is some overlap between a number of the proposals which requires clarification to avoid duplication.

## **6. CONCLUSIONS AND RECOMMENDATIONS (based on ToR in Annex I)**

The specific questions posed in the Terms of Reference (Appendix 2, Annex 1) are shown in italics at the beginning of each subsection.

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

#### **6.1.1 Use of Scientific and Commercial Information**

*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?*

I have assessed the use of scientific and commercial information in Section 3 above and have identified a number of shortcomings. These generally relate to lack of clarity in the way information has been used or presented (e.g. identification and ranking of threats) but also include some examples where additional information could usefully have been provided (e.g. climate change scenarios). There are a significant number of errors and omissions from the Literature Cited.

### **6.1.2 Use of Opposing Scientific Studies or Theories**

*'Where available, are opposing scientific studies or theories acknowledged and discussed?'*

As indicated previously, there are major shortcomings in the organisation of the references in the Recovery Plan. Many of the cited references are not included in the Literature Cited, and a number of citations are ambiguous. In addition, a significant proportion of the references are in the grey literature and so not readily available from libraries or the internet. It has therefore proved very difficult (and in many cases impossible) to assess the use of supporting information in the Plan.

One significant problem faced by the authors of this Recovery Plan is the paucity of data on the SCCC steelhead populations. As a result it appears that greater use might have been made of information on steelhead populations in other regions. I have noted two particular examples above. I have suggested that greater use might have been made of other Recovery Plans, for example in determining appropriate recovery criteria. In addition, I have suggested that climate change scenarios should be explicitly described in the Recovery Plan and used to help identify and prioritise actions.

### **6.1.3 Assessment of Scientific Conclusions**

*'Are the scientific conclusions sound and derived logically from the results?'*

I have discussed the scientific conclusions in the Recovery Plan in Section 4 above and summarised the principal concerns in Section 5. I have noted particular issues in relation to the threat assessment procedure, the development of recovery criteria and the identification and prioritisation of recovery actions.

The threat assessment is based on the CAP Workbook process, but neither the process itself nor the way that is applied for this Recovery Plan are explained in any detail. More information should be provided on how the threat assessment was actually undertaken and threats (rather than sources of threats) should be more clearly identified.

While the difficulties of establishing recovery criteria when the available data are so sparse must clearly be recognised, there are serious shortcomings in the identified criteria. Since several of the recovery criteria require further research to be quantified or improved, the Recovery Plan should describe clear interim objectives and criteria, which will be used for the short-term until better delisting objectives and criteria can be determined. In addition, to explaining why these objectives/criteria are undeterminable at present, the Plan should include the actions necessary and timelines to obtain the pertinent information and develop recovery objectives and criteria once the information is obtained.

The Recovery Plan identifies a large number of recovery actions which will clearly address potential significant problems and assist in the recovery of the SCCC steelhead DSP. However these actions are poorly structured such that they are not related to the recovery objectives or the listing factors and it is not possible to identify (except by common sense) where actions may be inter-related or conditional upon each other.

Furthermore they do not identify timelines, durations, costs or responsible parties, and so the lists do not provide a clear basis for prioritising activities within a recovery programme. No consideration appears to be given to benefit/cost analysis to assist in identifying and prioritising appropriate actions.

## **6.2 Evaluate the recommendations made in the plan.**

### **6.2.1 Standards for Recovery Plans**

*'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?'*

NMFS (2007) indicates that the primary purposes of a Recovery Plan is to:

- 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
- Identify goals and criteria by which to measure the species' achievement of recovery

All these requirements are addressed to some degree, but the foregoing discussion highlights significant failing in most areas. The Plan includes some proposals for site specific management actions but in general the proposals are still relatively vague. As indicated above the criteria are not generally objective or measurable and they lack estimates of time and cost.

NMFS (2007) also lists the following secondary functions for Recovery Plans:

- Serve as outreach tools by articulating the reasons for a species' endangerment, as well as why the particular suite of recovery actions described is the most effective and efficient approach to achieving recovery for the species
- Help potential co-operators and partners understand the rationale behind the recovery actions identified, and assist them in identifying how they can facilitate the species' recovery
- Serve as a tool for monitoring recovery activities
- Be used to obtain funding for NMFS and its partners by identifying necessary recovery actions and their relative priority in the recovery process

The Recovery Plan certainly contains a lot of information that will assist in outreach to stakeholder groups, but there are a number of areas where the clarity of presentation could be improved. For some threats, such as the removal of impassable barriers, the Plan clearly articulates the rationale behind the proposed recovery actions. However, stakeholders may be more uncertain about the rational behind actions to alleviate some other factors that have more subtle effects on the populations.

It is not clear that the proposed actions in the Recovery Plan are sufficiently clear or precisely defined to be usefully employed in seeking funding opportunities.

### **6.2.2 Species' Extinction Risk**

*'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?'*

The assessment of extinction risk in the Recovery Plan is used to try to set a threshold level for the recovery criterion of mean annual run size; it is not used to assess the current extinction risk *per se*. Such an analysis would probably not have been very helpful, both because of the lack of data on current runs in most watershed and the extreme uncertainty over the extinction risk assessment.

As discussed above, the Recovery Plan does not provide a clear presentation of the threat assessment or the recovery criteria. Indeed the lack of a clear presentation is probably a greater problem than the actual information itself.

### **6.2.3 Guidance For Stakeholders**

*'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?'*

For the various reasons discussed above, the Recovery Plan does not in its present form provide a clear basis on which the various stakeholder groups could easily organise and co-ordinate actions to promulgate recovery of the SCCC steelhead DPS even in the short term let alone for several decades. However, the plan clearly identifies the need for extensive collaboration and co-ordination between agencies and groups and the need to engage with and encourage all groups that may wish to undertake restoration work.

### **6.2.4 Research and Monitoring Recommendations**

*Review the research and monitoring recommendations made in the Report and make any additional recommendations, if warranted.*

This issue is addressed in Section 4.4 above.

## **APPENDIX 1: BIBLIOGRAPHY**

### **A. Material provided by CIE as key source documents**

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- National Marine Fisheries Service (2009) South-Central California Steelhead Recovery Plan. Internal Review Draft Version: July 2009. 363pp.

## **B. Other material referred to or used in this review**

[NB Documents marked \* have not been accessed/examined.]

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## **APPENDIX 2: STATEMENT OF WORK FOR TED POTTER (CEFAS)**

### **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.

**Task 1 - Necessary Preparation Prior to the Peer Review:** 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 Shivilani, CIE lead

coordinator, via [shivlanim@bellsouth.net](mailto:shivlanim@bellsouth.net) and to Dr. David Die, CIE regional coordinator, via [ddie@rsmas.miami.edu](mailto: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](mailto: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.

**Key Personnel:**

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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