United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

In Reply Refer To:
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OCT 20 2006

Memorandum

To: Regional Directors, Regions 1, 2, 3, 4, 5, 6, and 7
Manager, California/Nevada Operations Office
(Attention: Regional Endangered Species Chiefs)

From: Director H Dale Hall

Subject: Draft Guidance for Conducting Threats Assessments Under the ESA
(Comments Due: 30 days from date of signature)

This memorandum transmits draft guidance for conducting threats assessments under the Endangered Species Act for your review and comment. This guidance is likely going to have the most application in the listing/delisting and recovery programs, however, the process may be modified to be used in other parts of the endangered species program such as conducting a consultation. The intent is to provide guidance and tools to develop more systematic, transparent, and understandable threats assessments, supported by a series of well-reasoned arguments. Threats assessments developed using this framework can help provide a clearer, more defensible bases for making decisions on the classification of species, the strategy for a recovery program and prioritization of recovery actions, five-year status reviews and the likely effects of a proposed action during the section 7 consultation process.

Please submit your comments to Richard E. Sayers, Chief, Division of Consultation, Habitat Conservation Planning, Recovery & State Grants within 30 days from the date of this memorandum. If you or your staff have any questions or feedback, please contact Richard E. Sayers, Chief, Division of Consultation, HCPs, Recovery and State Grants (703-358-2171), or Michelle Morgan, Chief, Branch of Recovery and Delisting (703/358-2061).

Attachment

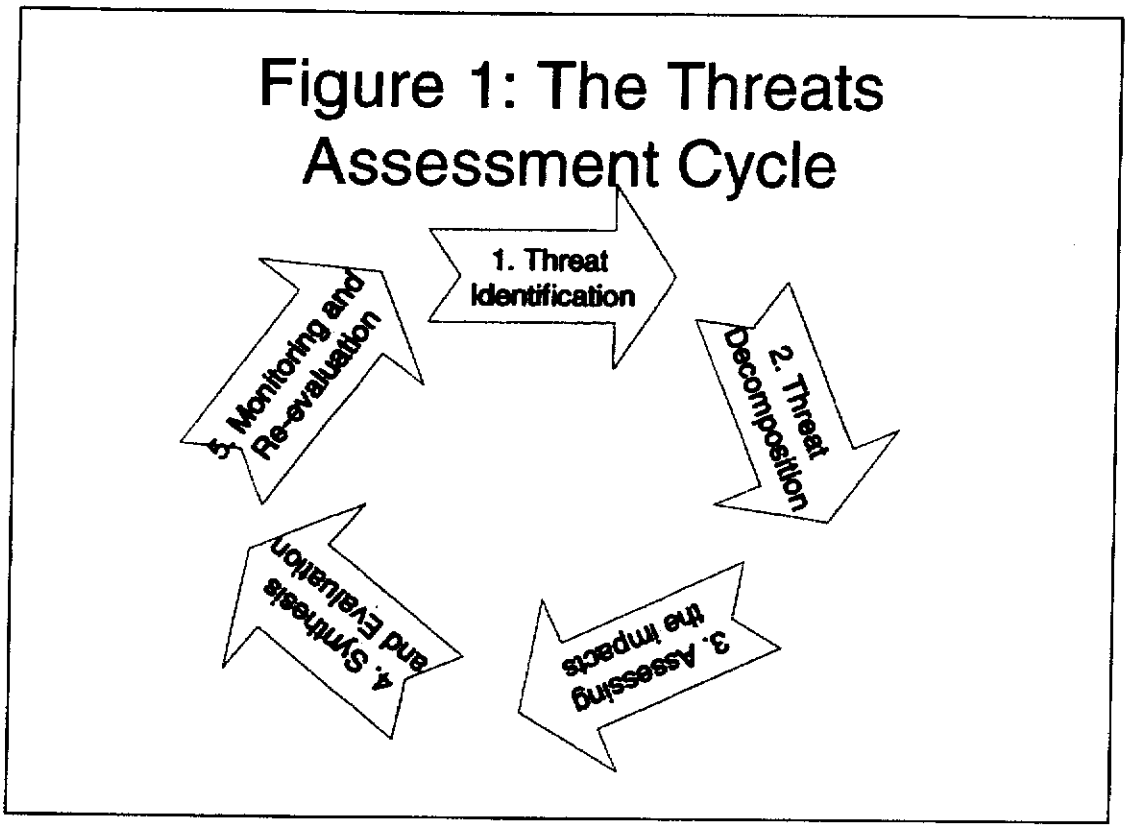
-Draft-

Guidance for Conducting a Threats Assessment for the Purpose of Endangered Species Status Assessment and Management

What is a Threats Assessment? A *threats assessment* in the endangered species context is a tool for systematically identifying and analyzing the threats that impact a species. The threats assessment is important to a number of endangered species applications, including candidate determinations, listing and delisting decisions, petition findings, and recovery planning and implementation. The same framework can also be applied to assessing proposed project impacts for consultations. Depending on the information available, threats assessments may range from very detailed and quantitative to generic and qualitative. Regardless of their detail or level of quantification, good threats assessments are systematic, transparent, supported by a series of well-reasoned arguments, and understandable by others not intimately familiar with the situation being evaluated.

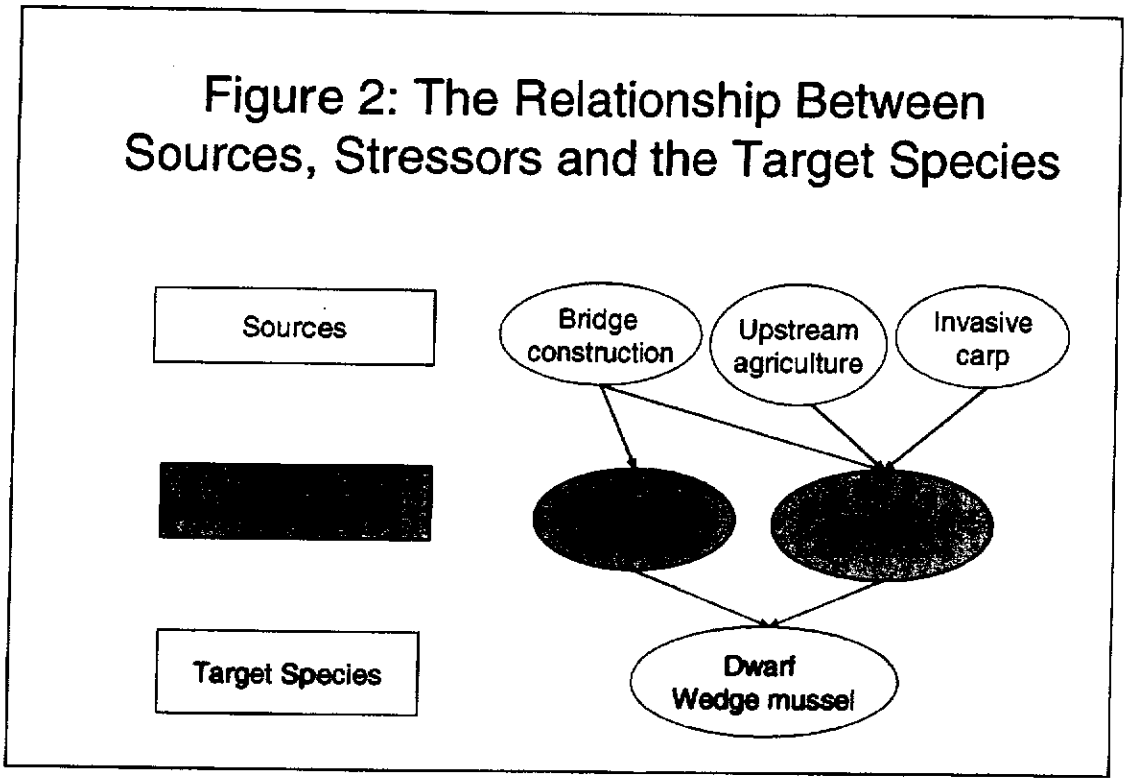
Why perform a Threats Assessment? The ESA recognizes the central role that threats have in both the endangerment and recovery of species by requiring decisions to list, reclassify, or delist species to be based on an analysis of the five "listing factors" (ESA section 4(a)(1)). Historically, however, most listing/reclassification/delisting rules, recovery plans, and 5-yr reviews to date have confined themselves primarily to identification and description of the known and likely threats and a list of potential mitigation actions. A threats assessment can be viewed essentially as a more formal, systematic approach to the 5-factor analysis. For classification and five-year review purposes, the Service needs to examine how and to what extent threats impact the species such that it meets the definition of threatened or endangered. A threats assessment can be a powerful tool to assist in providing the proper context for evaluating the likely effects of proposed actions during the section 7 consultation process. A better understanding of the relative impacts and sources of various threats can help determine both the relative priority and specific targets for remedial action to ensure more effective and efficient recovery. Finally, more detailed assessments of threats across many candidate assessments, listing decisions, recovery plans and 5-year reviews might also help the Service identify which threat sources present more pervasive problems for endangered and threatened species locally, regionally or nationally, than others. This would allow for development of more effective, generic threats avoidance and mitigation than the current species-by-species, one-threat-at-a-time approach. By more systematically evaluating the population-level effects of each threat through a threats assessment, the Service can make better decisions in all aspects of the Endangered Species Program.

What are the Primary Elements of a Threats Assessment? Threats assessments may vary considerably in focus and detail but all are composed of the same basic elements, carried out in an iterative fashion throughout the ESA process (Figure 1). Once a threats assessment is performed as part of a candidate assessment determination, then it only needs updating or revision to contribute to a proposed rule at a later date. Should a species be listed, the threats assessment may only need to be updated or revised to be used in recovery planning, etc.



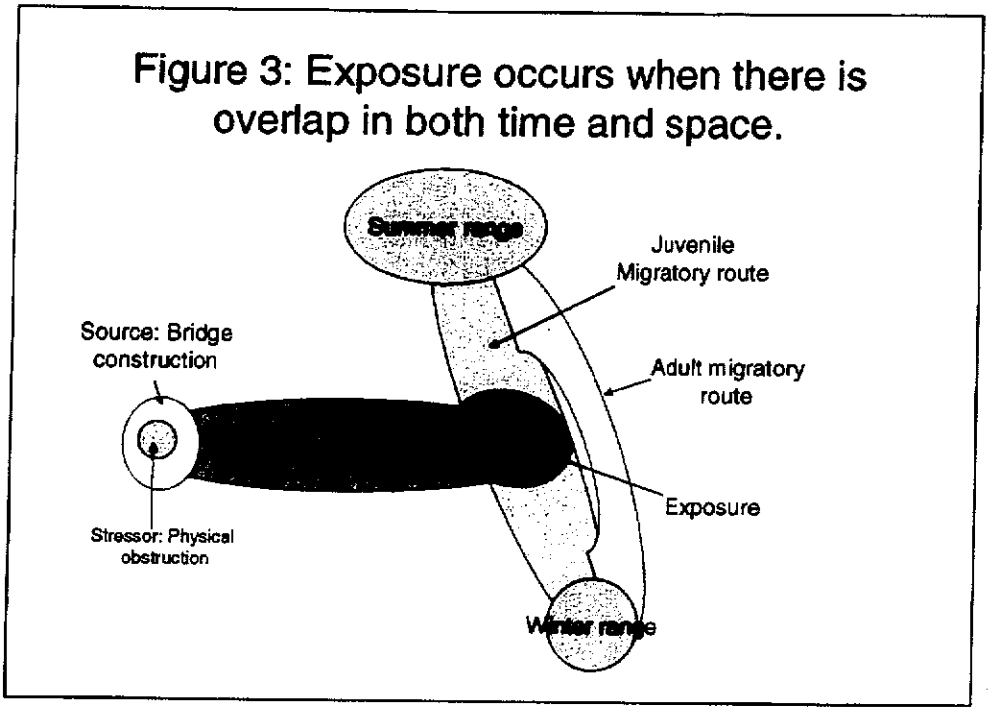
1. Threat Identification - A thoughtful, systematic examination of what is known about a species' life history, particularly in the context of the 5 listing factors identified in the ESA, can help identify threats, including those that may not yet have been considered. This should include reviewing all available literature, consulting with species experts, and soliciting information from those living and interacting with the species. The section titled "How Can I use the 5 Listing Factors Under the ESA to Identify Threats" provides more detail on threat identification specifically within the ESA 5-factor context.

2. Decomposing the Threat – In order to better understand how the threat actually effects the species, a threats assessment partitions each identified threat into a ***stressor(s)*** (words in **bold** are defined in the glossary), which actually impacts individuals of the species (e.g., siltation) and helps assess the magnitude of the impact, and the ***source(s)*** of the stressor (e.g., upstream bridge construction vs. agriculture), which often provides insight as to how to alleviate the threat. Thus the terms 'threat' and 'listing factor' in the endangered species arena usually refer to a composite of both the source and the stressor, which is decomposed into its components in the process of a threats assessment. At times, a single "threat" may actually comprise not only one or more stressors but also one or more sources (Figure 2). For example, siltation affecting a listed mussel in a freshwater habitat might have its source in one or more of upstream bridge construction, agriculture, or the behavior of an invasive species such as introduced carp (which stir up bottom sediments), each of which might require a very different remedial action. The threats assessment evaluates each stressor for its ***scope, immediacy***, and ***intensity***, as a way of identifying the true magnitude of the potential threat to the target species.



3. Assessing the Impact – A threats assessments characterizes both the ***exposure*** of the target (in this case individuals of the imperiled species) to the stressors, and the ***response***, at the individual, population, and ultimately the species level, in terms of demographic changes.

    a. Exposure - The actual exposure of the species to the stressor is an important factor in the effective impact. Things to consider in assessing exposure include the number of individuals to be exposed, the proportion of the total population exposed, are the affected individuals reproductive females of a slow to mature species or first instars of a r-selected species. Even if a stressor is capable of causing a major effect on individuals of a species, it is possible that the species is rarely, if ever, *exposed* to that stressor (Figure 3). This might be a result of non-overlapping geographic ranges such as the physical obstruction stressor caused by the bridge construction in Figure 3. Or it might be that the stressor causes a major impact on adults, however in the real world the species is only exposed to the stressor in its juvenile stage. In this case, such a threat might ultimately have a lesser impact on the species than another threat of lower intensity but with higher effective exposure.



b. Response - The siltation described under bullet #2 above might affect a listed fish directly, by clogging its gills and causing suffocation, or reducing egg survival, and/or indirectly, by reducing nearby plant photosynthesis which might in turn reduce a food source and/or reduce available oxygen in the water, each of which, in turn, might elicit a different physiological response. Alternatively, it is possible that the species could respond with a behavioral action, like moving to a different stream segment, that would avoid or minimize exposure. Presuming that the alternate streams segment provides equal fitness without extra stressors, the ultimate impact of the threat might be less in such a case. While the species' response might sometimes first be described as a behavior (such as avoidance) or a physiological response of individuals, whenever possible the response to each threat ultimately needs to be expressed in demographic terms. Thus it is important to consider the likely effect of the individuals' responses on their growth, fecundity, and mortality rates, and to aggregate the responses of individuals into an estimate of the response at the population or species level. A threats assessment must also consider the potential for stressors to act synergistically or antagonistically.

4. Synthesis and Evaluation – Once the impacts are expressed in common metrics, they may be compared across the array of known threats to which a species is exposed during its life cycle to evaluate the relative importance of each threat to the species' persistence and recovery, allowing the threats to be ranked in order of importance. Such a comparison can take a simple, tabular form, or a more elaborate form (e.g., a model), depending on the complexity of the situation and the information available. For example, in the case of a narrow-ranged endemic species with

only a few threats, all of the material might be readily organized in a single table such as that shown in Figure 4.

Figure 4: Sample Assessment Tool

Stressor	Scope	Immediacy	Intensity	Exposure	Response	Overall Threat level
A						
B						
C						
D						
E						

For some species, especially those with multiple populations or life stages which might have differing complex threats acting on them at different times and places, it will be necessary to synthesize the material compiled for the various threats and populations into a summary table (Figure 5) that collapses all the information in one place to allow meaningful evaluation of the overall threat levels to the species. If the information has been quantitative enough, it may be possible to develop a method of conversion to a common unit for this synthesis (Box 1). In the case of more qualitative information, it might be possible to develop a rule set for condensing the information. For example, if a stressor has a high impact for at least two populations it is designated a high threat overall, whereas if it is considered high for only one population out of five, it is designated only a medium level threat to the species overall. The rule set would need to be defined to accommodate the specifics of the circumstances and information available for each species individually.

Figure 5: Possible tool for evaluating multiple threats across multiple populations

Stressors/ Populations	Pop 1	Pop 2	Pop 3	Pop 4	Species
Stressor A					
Stressor B					
Stressor C					
Stressor D					
Sum of Stresses	Pop 1 Sum	Pop 2 Sum	Pop 3 Sum	Pop 4 Sum	Species Sum

Box 1: Loggerhead sea turtles delay reproductive maturity until 25-35 years of age, spend varying lengths of time in each of a series of geographically disparate developmental habitats, and then produce large numbers of eggs on an irregular schedule for potentially many decades. Over the course of this life cycle they are exposed to widely differing stressors, some well known and others less so. This made it difficult to evaluate the relative importance of the loss of large numbers of eggs and hatchlings to erosion and beach predators, versus losses of juvenile turtles to shrimp trawlers and high seas fishing gear, versus the loss of adult females to poaching and nearshore trawling gear. Crouse et al. (1987: pages 1412-1423) developed a relatively simple, stage-based, matrix projection model and performed sensitivity and elasticity analyses on the model that facilitated comparison of the relative impacts of varying fecundity and survival for each life stage on the intrinsic rate of growth of the population. It turns out that threats affecting the juvenile and sub-adult turtles have a much larger impact on population growth than threats affecting huge numbers of eggs or hatchlings (Crouse et al. 1987: page 1419; NRC 1990: pages 71-72). The current loggerhead sea turtle recovery team is developing a threats assessment that converts all of the impact evaluations for various stages into an adult female loss equivalency for comparison across threats and populations (Schroeder, pers. comm.).

5. Monitoring and Re-evaluation – The threats facing species, and the effects of those threats, may change through time and with management intervention. The value of the iterative nature of threats assessments throughout the ESA process is maximized by monitoring both the threats and the species' response. This allows for better estimation of the scope, immediacy, and intensity of the threats, and for noting changes in the threats and the species' response as various management actions are implemented. Indeed, this sort of monitoring is essential to applying adaptive management to real time endangered species management, which requires incorporating the response to the previous management activity into the model for better decision-making.

How Can I Use The 5 Listing Factors under the ESA to Identify Threats? The five listing factors presented in the Endangered Species Act allow all threats to imperiled species to be effectively categorized under one or another of the five factors according to common characteristics. Therefore, the five factors can be viewed as an organizing tool to think about threats and how these threats may or may not affect extinction risk in a more organized, methodical manner. It is also important to keep in mind that, at first glance anyway, some threats may seem to fit under more than one category, but this should not justify counting a threat multiple times. For example, some invasive species might be categorized as competitors or as habitat modifiers. It is usually preferable to encompass a threat under only one of the five listing factors. Where it clearly appears to be functioning as two stressors fitting under two threat factors, the differences need to be explained, and care needs to be taken to parse the effects appropriately so as to avoid inadvertently overweighting the effects of the source.

Factor A: The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range - All threats that affect a species' habitat and/or distribution can be categorized under listing factor A. Species use habitat for a variety of life functions (foraging, breeding, resting,

over-wintering, raising young, migration, etc.). Consider each of the life functions for which the species in question may use habitat (Box 2 - Factor A) and evaluate whether the absolute quantity of habitat, the arrangement of habitat, the connectivity of habitat units, the quality of the habitat, etc., contribute to the species' being threatened or endangered.

Box 2: Factor A. Destruction, Modification or Curtailment of Habitat

Examples of Habitat-types a Species Might Use

- foraging
- resting
- breeding
- nesting
- developmental
- migratory
- over-wintering

Examples of How Habitat Might be Altered

- change in total quantity
- change in amount of specific habitat available for important life history function
- change in connectivity
- altered configuration among different types of habitat
- altered physical structure
- contamination

If habitat quantity or quality for any of these life functions is a limiting factor, assess which stressors might be contributing to that limitation and the source(s), scope, immediacy, and intensity of each stressor. This is often where threats due to invasive species are addressed as well, since they frequently are expressed in terms of reduction of habitat quality (pollution) or quantity (competition). This might also be a good place to discuss a loss of pollinators due to the use of pesticides or some other factor, even if the pollinators themselves are impacted outside the range of the listed species. A similar deconstruction and analysis can be performed relative to changes in the species' range or distribution. A table or spreadsheet can be a useful tool for this analysis (Figure 6), where the rows identify known attributes of habitat or range that provide value to the species. For each habitat attribute, the sub-rows would identify the potential stressors affecting that attribute and the columns would assess the scope, immediacy and intensity of each stressor and the species' actual exposure and response, in order to evaluate the relative importance of each threat to the species.

Figure 6: Example Habitat Threats Assessment

Factor A: Habitat attribute	Stressor	Scope	Immediacy	Intensity	Exposure	Response	Overall Threat Level
1. Breeding habitat							
	Loss of total acreage	Omni-present	Imminent (Currently ongoing)	Low	Significant	Moderate (Reduction in fecundity)	Medium
	Loss of nest trees (structure)	Moderate	Historic (Hurricane 10 yrs ago)	Medium	Moderate	Basic need inhibited (Reduction in fecundity)	Medium but declining
	Pollution	Localized	Future (Under construction)	High	Small	Mortality (Reduced survival of young)	Low
2. Foraging habitat							
	Inedible invasive grass	Regional: SE US	Near future (Spreading; expected to reach species range next year)	Low now, but increasing over next decade	Insignificant now, but spreading to Moderate over next decade	Short-term: Behavioral; long-term: Moderate reduction in growth and fecundity	Low but increasing

Factor B: Overutilization For Commercial, Recreational, Scientific, or Educational Purposes - Consider each of these potential uses (commercial, recreational, scientific, or educational) to determine whether they might be occurring. If take is occurring for more than one (e.g., recreational) use, consider each of these stressors separately, and evaluate whether, and how much, the species is exposed to the stressor, what its biological response is when exposed, and the scope, immediacy and intensity of the stressor itself. For example, a charismatic species, such as the bog turtle, might be subject to commercial take for international trade as well as take by local collectors, but the magnitude and threat level for one might be quite different than for the other. Factor B can also be an appropriate place to evaluate incidental, rather than directed, takes due to commercial, recreational, scientific or educational activities, such as incidental bycatch in commercial fisheries.

Factor C: Disease Or Predation – Again, consider disease and predation separately. A species might be vulnerable to several diseases and several predators; consider each separately, as each might act upon the species differently. Does the disease cause actual mortality, or is its impact expressed in reduced fecundity? Is the disease inherent in the natural population or is there an invasive species acting as a vector, whose dynamics also need to be deconstructed? A historically natural predator may become a threat if its population has increased unnaturally, or the listed species' population is reduced to the point it can no longer withstand historical

predation levels. Remember to include invasive species that might transmit diseases or prey upon the target species here as well.

Factor D: The Inadequacy of Existing Regulatory Mechanisms – The frame of reference for evaluating this factor is: What regulatory mechanisms exist without the ESA in place? The question then becomes: Would/Does listing under the ESA provide additional regulatory mechanisms necessary for conservation of the species? Frequently, a species and/or its habitat are subject to various regulatory mechanisms outside the ESA framework. For example, many aquatic species are influenced by minimum sustained flows, water temperature fluctuations, and siltation issues, which are in turn frequently the subject of regulation of upstream dams and/or agricultural diversions. These regulations should be evaluated for their adequacy to maintain the conditions necessary for the species' conservation. When working on recovery plans, delistings, and 5-year reviews it is important to assess whether existing regulations that facilitate recovery are ESA-dependent and, if so, what would happen after delisting and removal of ESA authority for the regulations.

Factor E: Other Natural or Man-Made Factors Affecting Its Continued Existence – Most threats to species can, and should, be classified under one of the first four factors, however, the ESA provides Factor E for meaningful threats that cannot be otherwise categorized. For example, small or declining populations can be particularly vulnerable to both stochastic and deterministic genetic and demographic issues, such as inbreeding, genetic drift, the loss of genetic variability, random variations in male to female ratios, birth rates, and death rates, catastrophic events such as hurricanes, unpredicted geological events, drought, changing climate patterns, etc. Factor E is the appropriate place to assess these sorts of issues and their relative importance to candidate and listed species. A useful set of concepts to keep in mind when evaluating threats relative to the genetic and demographic issues of small or declining populations is that of representation, resiliency, and redundancy (Shaffer and Stein 2000: pages 307-310). Essentially, to ensure long-term persistence of a species it is important to ensure:

- representation of the full ecological and genetic diversity of the species to facilitate adaptation to natural or human-caused perturbations (e.g., global climate change);
- population sizes (with individuals distributed appropriately among both age classes and sexes) that provide resiliency in the face of random genetic and demographic fluctuations (genetic drift, etc.);
- sufficient replication of subpopulations or populations (redundancy) to recover from catastrophic events such as major hurricanes, volcanoes, diseases, etc.

Other threats that might be treated under Factor E might include hybridization with non-native fish or and concerns related to human attitudes, such as fear of and opposition to recovery of native predators, that are significant enough to affect a species sustainability or recovery' potential directly or indirectly.

What if I am unsure what the true threats are to the species? We are required to make ESA decisions based solely on the best scientific and commercial data available. In many circumstances these data will be less than fully conclusive and we must make rational inferences that reflect the extent of our uncertainty and consequences of being incorrect. As mentioned

above, threats assessments can vary in specificity depending upon the information available. It is also possible to have a number of postulated threats but no clear cause and effect information on which to assign causal responsibilities. Again, the toxicology literature provides a methodology for making causal inferences in situations like this (Suter et al. 2002: pages 1101-1111). Suter et al. provide guidance for analyzing the available information (such as spatial or temporal associations of potential causes and effects) to generate causal evidence, and three non-exclusive methods to infer the cause: elimination of causes, diagnostic protocols, and analysis of the strength of evidence. As mentioned earlier, where the specific degree of impact cannot be calculated, it can be estimated from the scope, immediacy, intensity, exposure and response. A proposed rule set for a more qualitative assessment of impact is shown in Appendix A.

Is There More than One Approach to Conducting a Threats Assessment? Threats assessments come in a variety of shapes and forms. These range from the highly detailed, quantitative approach that the EPA uses for assessing the risks to humans or ecosystems from chemical or radiation exposure to a more conceptual, heuristic approach based on informed estimates and life history models like that used by the National Research Council Committee on Atlantic Salmon in Maine (NRC 2004: pages 108-137). The particular approach taken to any specific threats assessment needs to be guided by both the quality and depth of the information known about the species in question. Background documents of particular value when beginning to think about your threats assessment include Risks and Decisions for Conservation and Environmental Management (Burgman 2005: pages 1-165), the EPA Guidelines for Ecological Risk Assessment (1998: pages 1-188) (http://www.epa.gov/NCEA/ecorsk.htm), Chapter 4 (Stress/Source Worksheet) of The Nature Conservancy (TNC) Conservation Action Planning Workbook User Manual (version 4.b., March 2005: pages 32-41; or the most current version, available at http://www.conserveonline.org/), and Chapter 4 (Setting Priorities for Action: Risk Assessment and Decision Analysis Basics) of the National Research Council report on Atlantic Salmon in Maine (2004: pages 108-137) (http://www.nap.edu/books/0309091357/html/108html).

Similarly, depending on where in the overall ESA framework one is focusing, the emphasis of a threats assessment might take slightly different forms. For example, in recovery planning the focus would be to start with a presumably impaired species and work backward to identify its stressors, and the sources of those stressors, and forward to assess which have the most negative impact on the species in order to prioritize actions to mitigate stressors and their sources. On the other hand, a section 7 biologist who chooses to employ this method would be looking at the threats assessment process from the point of view of knowing the source (the action), with the purpose of identifying the stressors that source might produce and their magnitudes, and from there the exposure and response of each of the candidate and listed species which might occur within the impact area of the stressor.

Possible Variations on a Threats Assessment - Fortunately, the basic conceptual approach for threats assessments can be modified to accommodate various specifics about a particular situation. For example, some TNC threats assessments have been partitioned to evaluate historical threats (which no longer are occurring, but might require restoration activities), current threats (which might require actions to reduce or eliminate the current threat source) and potential threats (which might point to the need for threat-avoidance or preventative-type actions). Another assessment might emphasize details in the exposure/response interaction. A

variety of other modifications could be incorporated into this same basic framework, as needed, to accommodate the specifics about any particular recovery planning situation. For particularly complex situations, the EPA Guidelines for Ecological Risk Assessment (EPA 1998: pages 1-188) include a number of helpful questions to consider at various stages in the assessment process.

Keeping Your Threats Assessment Up-to-Date. A threats assessment may only be done once to determine candidacy or whether to list a species, but for recovery, consultation, 5-year review and reclassification purposes, it should be viewed as an iterative tool. For example, as recovery tasks are implemented to mitigate specific threats, the relative impact of those threats on the species should lessen, eventually allowing for re-prioritization of recovery actions and fine-tuning of the recovery program for the species. An update can usually be accomplished by simply reading through it thoughtfully to evaluate whether any of the sources, stressors, or species vulnerabilities have changed such that they might warrant revising the threats assessment or modifying your recovery program to meet new conditions. At a minimum, a revised threats assessment will be done in a species'-5-year review.

Glossary

Exposure – The extent to which a target resource and stressor actually overlap in space and/or time.

Immediacy – The action time frame of the stressor. I.e., is the stressor present and acting on the target now, anticipated in the future, or has the impact already occurred, in which case restoration is more appropriate than threat reduction.

Intensity – the strength of the stressor itself.

Response – The change in a species' behavior, reproductive capacity or survival due to a specific stress.

Scope – The geographic and temporal extent of the stressor.

Source – The action or identity from which a stress is derived.

Stressor – a process or event with negative impact on target species.

Threat – any circumstance or event with the potential to cause harm to the resource. In the context of endangered species management, the term threat encompasses both the source and the stressor.

Overall Threat Level – The integration of the scope, immediacy, and intensity of the stressor with the exposure and response of the species measured at the population or species level.

Threats Assessment – A structured approach to analyzing the relative importance of various threats to the target entity.

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Appendix A

Factors:

A. The present or threatened destruction, modification, or curtailment of its habitat or range
B. Overutilization for commercial, recreational, scientific, or educational purposes
C. Disease or predation
D. The inadequacy of existing regulatory mechanisms
E. Other

Scope (Geographic extent of threat factor occurrence):

1 Localized (e.g., 1 watershed, mountaintop, county, etc.)
2 Moderate (multiple watersheds, counties, etc.)
3 Regional (multiple states)
4 Omnipresent (nationwide)

Immediacy:

1. Future (effects anticipated in future)
2. Imminent (effects manifested immediately)
3. Historic (effects already realized, but restorative action necessary)

Intensity (strength of stressor)

1. Low ( )
2. Moderate ()
3. High ()

Exposure (Level of total known population exposed to threat source):

1 Insignificant (level of exposure negligible)
2 Small (< 10% of pop. exposed, no demographically impt. life stages compromised)
3 Moderate (11% - 30% of population exposed, or smaller % but some demographically important life stage involvement)
4 Significant (31% - 60 % of population exposed, or smaller % but significant involvement of at least one demographically important life stage)
5 Very significant (> 60% of pop. exposed or sig. inv. of 2 or more impt. life stages)

Response (level of physiological/behavioral response):

1. Behavioral (startle, displace, etc.)
2. Basic need inhibited (feed/breed/shelter, possible reduction in growth rate, reproductive rate or survival)
3. Mortality confirmed (or identifiable reduction in growth rate, reproductive rate or survival)
4. Significant mortality (or significant reduction in growth rate, reproductive rate or survival)

Overall Threat Level:

1. Low (at this point in time, no action is needed)
2. Moderate (action is needed)
3. High (immediate action necessary)
4. Severe (immediate action essential for survival of the species)