A MATRIX-BASED CEA PROCESS FOR MARINE FISHERIES MANAGEMENT[a]

by

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ABSTRACT

Summarized herein is a matrix-based, two-component process for planning and conducting cumulative effects assessment (CEA) studies to be incorporated into environmental impact statements (EISs) and environmental assessments (EAs) prepared for Marine Fishery Management Plans. The process incorporates CEQ's 11-step CEA approach divided into two components – scoping and baseline, and impact analysis. Each component is comprised of requisite building blocks from the 11 steps. For example, scoping and baseline integrates affected environment information for selected VECs (valued ecosystem components) with effects information from other fishing and non-fishing actions to define the CEA Baseline. The impact analysis component integrates the CEA baseline findings with the direct and indirect impacts of alternatives on the VECs to determine cumulative effects. The identified cumulative effects are then evaluated relative to their significance, and necessary follow-on activities such as monitoring and adaptive management. Practical approaches are described for each building block and the development of matrix tables which can be used to summarize the findings. Key lessons include: (1) multiple matrices will be needed to address the contributions of direct/indirect effects of proposed actions and other actions (past, present, and future) on pertinent study VECs; (2) this usage can provide a consistent approach for both identifying and evaluating cumulative effects; further, the rows and columns in specific matrices can be modified to meet specific study needs; (3) net impact summary information in individual matrix tables can inform decision makers and the decision making process: (4) when effects codes are used (positive, neutral, negative, etc.), the codes should be clearly defined in the text and, if appropriate, in footnotes to the tables; and (5) the two-component process provides the basis for a "hard look" (a phrase used in USA court decisions as a test of NEPA documentation adequacy), and it is in compliance with United States case law findings related to CEA.

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INTRODUCTION

Cumulative effects assessment (CEA) is a relatively new topical issue which is being addressed in National Environmental Policy Act (NEPA) compliance documents in the United States. The term "cumulative impacts" was originally introduced in early 1970s guidelines promulgated by the Council on Environmental Quality (CEQ); and a definition was incorporated in the CEQ's NEPA regulations published in 1979 (Council on Environmental Quality, 1986). For example, cumulative effects (impacts) refer to the impact on the environment which results from the incremental effects of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (Section 1508.7).

In the 1980s and early 1990s, some attention was given to CEA in environmental impact statements (EISs) and environmental assessments (EAs); however, the extent of coverage was widely varied, primarily because no specific implementing process had been promulgated. In 1997, the CEQ issued a guidance report, also referred to as a handbook, which described an 11-step CEA process (Council on Environmental Quality, 1997). The availability of this process, as well as increasing litigation related to the inadequacy of CEA within EISs and EAs, quickly prompted numerous Federal agencies, including the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service, to give increased attention to this topic.

Regarding the inclusion of CEA within NEPA compliance documents, numerous scientific and policy challenges were soon recognized. One example of such a challenge for NOAA Fisheries Service is the context problem of considering the effects (impacts) of an FMP (Fishery Management Plan) comprised of multiple fishery management measures within the same spatial areas wherein other FMPs exist for coinciding fisheries. Another key challenge is accounting for the dynamic nature of target fish species within an FMP; for example, there may be seasonal movement patterns which are over large spatial areas. Further, the effects of gear types for one fishery may disturb the habitat and essential fish habitat (EFH) for the target species and other concurrent managed species. Uncertainties also exist relative to combining effects on common resources; that is, are the effects additive or non-additive?

Despite the challenges noted above, the body of knowledge related to cumulative effects on marine fisheries has expanded over the last decade; thus, a more defined process for CEA can be articulated for both new FMPs and proposed modifications to existing ones. This process is both practical and cost-effective, and it can be included in the final part of Environmental Consequences sections within EISs or EAs or as a separate Cumulative Effects section. The process has potential application to all six Regional Offices of NOAA Fisheries

Service. Further, it could be applied by governmental agencies in other countries engaged in marine fisheries management.

Following this brief introductory section is a section which summarizes CEQ's 11-step process. The third section, and the major one, describes an integrated approach for conducting CEAs for FMPs. The approach is based on a conceptual model for developing the CEA Baseline and then analyzing the incremental (direct/indirect) effects from the preferred and other alternatives along with cumulative effects. Depending on the significance of the cumulative effects, follow-up activities related to monitoring and adaptive management may be needed.

The fourth section focuses on the presentation of CEA findings in EISs or EAs, and the fifth one highlights two special challenges in CEA for marine fisheries – ecosystem-based management and how common effects actually accumulate. Conclusions are articulated in the final section and the utilized references are then cited.

CEQ'S 11-STEP PROCESS

The 11-steps within the CEQ process include (Council on Environmental Quality, January, 1997):

- Step 1 -- identify the significant cumulative effects issues associated with the proposed action and define the assessment goals.
- Step 2 -- establish the geographic scope for the analysis.
- Step 3 -- establish the time frame for the analysis.
- Step 4 -- identify other actions affecting the resources, ecosystems, and human communities of concern. (Resources, ecosystems, and human communities can also be referred to as Valued Ecosystem Components, or VECs.)
- Step 5 -- characterize the resources, ecosystems, and human communities (VECs) identified in scoping in terms of their response to changes and capacity to withstand stresses.
- Step 6 -- characterize the stresses affecting these resources, ecosystems, and human communities (VECs) and their relation to regulatory thresholds.
- Step 7 -- develop a baseline condition for the resources, ecosystems, and human communities (VECs).

- Step 8 -- identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities (VECs).

- Step 9 -- determine the magnitude and significance of cumulative effects.

- Step 10 -- Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects.

- Step 11 -- monitor the cumulative effects of the selected alternative and adapt management.

Step 1 could be used to select appropriate VECs for study, while Steps 2 and 3 (spatial and temporal boundaries for each selected VEC) could be addressed in either the Affected Environment section (or chapter), or in the Environmental Consequences section, in an EIS or EA. Other actions (Step 4) include past, present, and reasonably foreseeable future actions which have, are, or will be contributors to combined effects on common VECs. These actions could be included in the Environmental Consequences section, or even in the Affected Environment section. Steps 8 through 11 are primarily associated with the Environmental Consequences section.

Steps 5 through 7 are specifically related to the Affected Environment section. Step 7 highlights the concept of a “baseline” condition. This condition could be reflective of an historical reference time and the trends in the conditions of the selected VECs from their individual reference times to the present. Baseline can also refer to anticipated future conditions. Step 6 is reflective of current conditions for the selected VECs, along with their evaluation in relation to regulatory thresholds and non-quantitative criteria associated with sustainability and compliance with pertinent guidance and policies. The term “stresses” suggests both past and current natural and societal-initiated actions which have been, or could be, influencing the conditions of the VECs. Finally, Step 5 infers that scientific and/or policy information may need to be assembled on the selected VECs in order to enhance understanding regarding their resiliency, response to changes, natural recovery, carrying capacity, etc.

Step 8 highlights the development of cause-and-effects relationships between human activities and VECs. Such relationships could be depicted by “conceptual models” which pictorially demonstrate connections between activities (and their stressors or impact-causing factors) and specific VECs or their indicators. Such models reflect the general state-of-knowledge related to such connections. Descriptions of the rationale should be provided, and information sources should be referenced for these types of models. Simple interaction matrices modified to address cumulative effects can be used to connect the effects of various actions on VECs, thus demonstrating cause-effects relationships.

The significance of the cumulative effects can be ascertained by using the generic definition of “significant”, based on context and intensity, as found in the CEQ’s NEPA regulations (40 CFR 1508.27). Further, additional FMP-related criteria are available. The specific NEPA regulations for NOAA Fisheries Service are in NOAA Administrative Order 216-6 (National Oceanic and Atmospheric Administration, 1999). Section 6.02 includes specific guidance on the significance of fishery management actions. This guidance expands the context and intensity definitions in Section 1508.27 of the CEQ’s NEPA regulations (Council on Environmental Quality, 1986). The NAO 216-6 regulations at Section 6.02 include the following “significance conditions”:

- The proposed action may be reasonably expected to jeopardize the sustainability of any target species that may be affected by the action; to jeopardize the sustainability of any non-target species; to cause substantial damage to the ocean and coastal habitats and/or EFH as defined under the Magnuson-Stevens Act (MSA) and identified in FMPs; to have a substantial adverse impact on public health or safety; to adversely affect endangered or threatened species, marine mammals, or critical habitat of these species; and to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species.

- The proposed action may be expected to have a substantial impact on biodiversity and ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc).

- If significant social or economic impacts are interrelated with significant natural or physical environmental effects, then an EIS should discuss all of the effects on the human environment.

- A final factor to be considered in any determination of significance is the degree to which the effects on the quality of the human environment are likely to be highly controversial. Although no action should be deemed to be significant based solely on its controversial nature, this aspect should be used in weighing the decision on the proper type of environmental review needed to ensure full compliance with NEPA. Socio-economic factors related to users of the resource should also be considered in determining controversy and significance.

Mitigation is identified in Step 10. A key question is – does the proponent agency for the action have to mitigate for all cumulative effects, or only for their incremental contributions to the determined cumulative effects? The answer to the question is “incremental contributions.” This principle is supported by the USEPA’s CEA review guidance (U.S. Environmental Protection Agency, 1999). However, the guidance does indicate that proponent agencies should consider inter-agency collaboration to address the management of cumulative effects resulting from multiple contributors.

Finally, Step 11 raises the issue of monitoring and adaptive management as follow-on activities to an EIS when there are major uncertainties associated with cumulative effects on one or more VECs. This issue is currently receiving more attention in both planning and reviewing EISs related to FMPs or amendments thereto.

MODEL FOR CEA BASELINE AND IMPACT ANALYSIS IN MARINE FISHERIES

A matrix-based, two-component, rearranged approach for conducting CEAs has been developed. Further, it should be noted that all 11 of the CEQ's steps are incorporated. The rearranged approach is shown in Figure 1 (Tomey, et al., 2006). Rather than a strictly linear process, two additive equations are shown, one for Scoping and Baseline, and the other for Impact Analysis. In addition, boxes are shown in Figure 1, and they can be conceptualized as building blocks for CEA. Finally, this new approach is not unprecedented as other agencies are promoting rearranged approaches; for example, the Bureau of Land Management in the U.S. Department of the Interior (Magee and Nesbitt, 2008).

The terminology used in Figure 1 relates to the CEQ's 11-step process as follows:

- Scoping and Baseline Component (SB) – reflects the Scoping phase (Steps 1-4), the Description of the Affected Environment phase (Steps 5-7), and Step 8 of the Determining Environmental Consequences phase of CEQ's process.

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- Existing Conditions/Status/Trends of Each Resource (Box SB-1) as captured in the Affected Environment Section of the EA or EIS – reflects Steps 5-7 of CEQ's process; the term VEC can be substituted for the term "resource."

- Past/Present/Reasonably Foreseeable Fishing Actions (Box SB-2), and Past/Present/Reasonable Foreseeable Non-Fishing Actions (Box SB-3) – these two boxes are reflective of Step 4 (other actions) and Step 8 (cause-and-effects linkages) in CEQ's process. The output of both boxes should be expressed in relation to effects on the conditions and trends of the VECs and their indicators.

- CEA Baseline (Box SB-4) – reflects the outputs of Steps 1-8 in the CEQ process. It should be noted that the CEA Baseline does not refer to the traditional use of the term "baseline" for impact studies (could be termed the Environmental Impact Assessment Baseline). The EIA Baseline

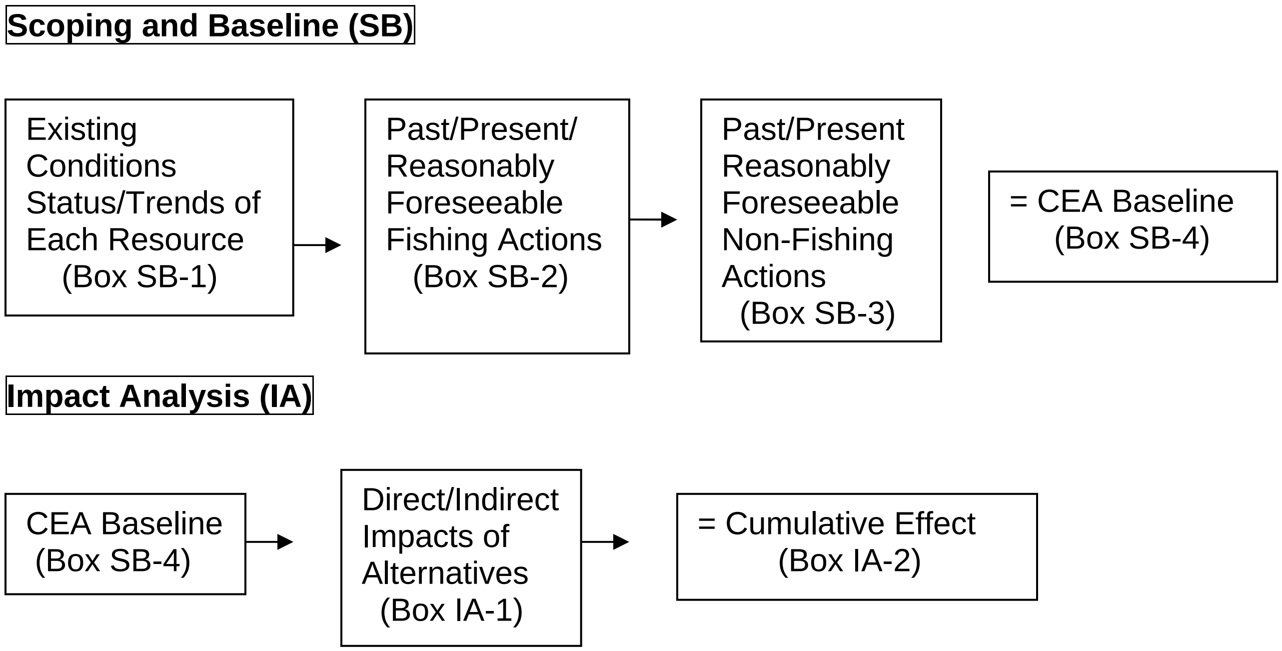

Figure 1: CEA Model for Baseline and Impact Analysis

Note: A suggested time-sequenced approach for addressing each box and component is as follows – address Box IA-1, Box SB-1, Box SB-2, Box SB-3, Box SB-4, and Box IA-2.

typically focuses on current (existing) conditions for the VECs as well as projections of future changes in these conditions if the “no project” or “no-action” (status quo) alternative is chosen. The concept of a CEA Baseline has been promoted by others; e.g., Magee and Nesbitt (2008)..

- Impact Analysis Component (IA) – reflects Steps 9-11 of the Determining Environmental Consequences phase of CEQ’s process.

- Direct/Indirect Impacts of Alternatives (Box IA-1) – reflects the results of Step 1 of the CEQ’s process. This step focuses on cumulative effects issues of concern, and identifying the direct/indirect effects of the preferred and other alternatives represents a beginning point for the study. Further, from the anticipated direct/indirect effects of this building block, the VECs to be utilized can be selected, and their spatial and temporal boundaries can be specified (Steps 2 and 3 of CEQ’s process).

- Cumulative Effect (Box IA-2) – reflects Step 9 (magnitude and significance of cumulative effects) and Steps 10 and 11 (mitigation, monitoring, and adaptive management) of CEQ process.

In terms of a time-sequence of activities in a CEA study, the following numbered boxes should be addressed. However, it should be noted that the boxes are related to each other, thus iterations within and between the boxes may be necessary.

<u>Box IA-1: Direct/Indirect Impacts of the Alternatives, including the Preferred Alternative, on Selected VECs</u>

The above definition of cumulative effects includes several features which need to be included within a systematic approach for identifying and assessing cumulative effects associated with EISs (or EAs). One feature is the need to identify the incremental impact(s) of the action. This phrase refers to the action; however, implicit in the word action is the need to identify the impacts of the original proposed action, the alternatives to this action, and the ultimately identified preferred alternative. Further, the word impact(s) denotes both direct and indirect impacts. In addition, impacts also infers spatial considerations; that is, where within a specific spatial area defined for the EIS will such direct and indirect impacts take place? A temporal feature is also inferred from impacts. For example, the impacts resulting from the preferred alternative and the other alternatives which were evaluated would be expected to start upon implementation and to extend for some time into the future. The future time period would be related to the period over which the management measures within the preferred and other alternatives would be utilized as well as accounting for some time beyond this period to allow for natural ecosystem recovery processes to take place. An historical reference point could be the time when FMPs within the spatial area were first developed. The mid-to-late-1970s could be used in many cases. Finally, it should be noted that Box IA-1 encompasses Steps 1-3 of CEQ's 11-step CEA process.

Selecting VECs for Analysis

Another inference from the word impacts is that they can occur on a broad spectrum of marine resources and ecosystems, as well as on fishery-related companies, ports, and their associated human communities. The term VEC, as defined above, can be used to depict important environmental features which would be subject to the direct/indirect effects of the preferred and other alternatives. Accordingly, an early activity in CEA should be focused on the selection of pertinent VECs, and indicators thereof, which would be subject to the direct/indirect effects. This early selection is also important in relation to the Affected Environment section of the related EIS or EA (see Canter 2008 for further guidance on the Affected Environment section). More specifically, the information in the Affected Environment section could be structured around the selected VECs. Examples of potential VECs which are often used in the Northeast Region of NOAA Fisheries Service include, but are not limited to:

- The managed or protected (e.g., target) species (could include one species for a species-specific action or multiple species in a multi-species action) -- The managed species could refer to either those subjected to previous management activities or to those to be addressed for the first time. The proposed action would be expected to have direct/indirect effects on the managed species within the defined spatial and temporal boundaries for the study. Such features could also cause direct/indirect effects on the habitat requirements (e.g., essential fish habitat – EFH and critical habitat units) for the managed or protected species.

- Other species within the defined spatial boundary for the EIS (or EA) -- These other species could also be subject to effects from the proposed action or from state-directed management programs through bycatch, for example. Conversely, they may not be managed under any Federal or state program. However, the connection to the managed or protected species being subjected to an EIS is that pertinent features therein could cause direct/ indirect effects on these other species, or on the habitat requirements (e.g., EFH and critical habitat units) of these species.

- The required habitat (e.g., EFH and critical habitat units) for the species addressed by the proposed action and, as appropriate, the habitat for the other species VEC -- In general, species have different habitat requirements for different phases of their life cycle. Further, considerable information is known about the effects of different gear types and fishing practices on a variety of types of habitat. As noted above, the direct/indirect effects of pertinent features of the proposed action could occur on both habitat of the subject species and of other fish species.

- Protected species which occur in the defined study area for the proposed action and which could be subject to direct/indirect effects from the proposed activities -- The protected species VEC encompasses whales, dolphins, turtles, and bird species subject to varying levels of protection under either the auspices of the threatened and endangered species designations within the ESA (Endangered Species Act) or the classification schemes within the MMPA (Marine Mammal Protection Act). It also includes designated critical habitat for any ESA-listed species. It is important to note that the occurrence of protected species in the study area is not the primary reason for a protected species VEC; rather, it is the actual or anticipated connections resulting from the direct/indirect effects of the proposed action and related management measures that should be emphasized in the related EIS.

- Human communities and businesses that have specific interrelationships with the proposed action -- This social and economic VEC can be depicted via other terms, such and ports and communities and the fishing industry. In this regard, this VEC is primarily related to both social and socioeconomic effects.

Following the selection of the pertinent VECs for a NEPA compliance document, consideration should be given to potential indicators for each VEC. In this case, the term indicator denotes a single parameter (or even a composite of several parameters) which is indicative of the conditions of the VEC, including its sustainability (Canter, 1996, pp. 122-123). Indicators for each VEC can be used as the basis for describing the historical and current conditions for the VECs in the Affected Environment sections in EISs or EAs. Additional information on the use of VECs and indicators as the basis for describing the Affected Environment is available elsewhere (Canter, 2008). Further, indicators can be used in the Environmental Consequences sections to depict anticipated changes in their conditions resulting from direct and indirect effects of the preferred and other alternatives, as well as the contributed changes from other actions (both fishing related and non-fishing related actions) within the defined geographical study boundaries and the identified temporal boundaries (past, present, and future).

Table 1 displays a matrix-based, structured approach for presenting VECs, actions affecting the VECs, potential cumulative effects resulting from all actions, and possible generic indicators (Morton and Tomey, 2006, pp. I-13 and I-14). The two right-hand columns could both be considered as indicator columns (the penultimate one relates to changes in the conditions of the VEC and the last one identifies composite indicators for the VEC changes). Further, the two right-hand columns could be utilized for organizing information and describing the historical and current conditions for each VEC in the Affected Environment section of a specific EIS or EA.

Table 1. Possible Actions, Effects and Indicators Considered in Cumulative Effects Assessments Listed by Affected Resource (Morton and Tomey, 2006, pp. I-13 and I-14)

Affected Resource of Concern	Proposed Regulatory Action Introduce or Change in:	Other Federal, Non-Federal Actions (Not Proposed under the Current Action) that Should be Considered (Past, Present, Reasonably Foreseeable Future)	Cumulative Effect of Proposed FMP Action and Other Actions	Possible Indicators
Target Species	• Fishing effort (*e.g.*, Total Allowable Catch, Days-at-Sea, Closed Areas, Trip Limits, Size Limits) • Fishing capacity (*e.g.*, # of Vessels) • Gear type/mesh size • Activation of Latent Effort • Fishery administration	• Existing FMP regulations • Bycatch limits of target species by other fishing regulations • Fishery management-related protected species restrictions and other protected species actions • Habitat restrictions of this/other fishery regulations and other habitat protective actions • Non-Fishing effects on target species • State Actions	• Change in population, abundance of target species stock(s) • Change in projected stock rebuilding time(s)	• Stock Abundance • Mortality
Non-Target Species	• Incidental/bycatch -Fishing effort -Fishing capacity -Gear type/mesh size -Closed Areas • Reduction of ghost fishing • Activation of latent Effort	• Bycatch limits of fishing regulations • Interactions with fishery practices of other fishery regulations • Protected species restrictions of fishing regulations and other protected species actions • Habitat restrictions of FMPs fishing regulations and other habitat protective actions • Non-Fishing effects on non-target species	• Change in population, abundance of non-target species stock(s)	• Stock Abundance • Mortality
Protected Species	• Gear type/mesh size • Protected species • Closed areas • Fishing effort • Fishing capacity	• Existing FMP regulations • Other protected resource actions, e.g., take reduction plans (closed areas and gear restrictions/modifications) • Other actions to protect habitat, EFH, HAPC, or fishing effort (closed areas and gear modifications) • Fishing/non-fishing threats to survival and	• Change in rate or type of protected species interactions • Increased mortality and decrease in population size of protected species • Altered critical habitat	• Abundance and distribution of Protected Species and prey • Measured and Projected Mortality • Abundance, distribution and status of Critical Habitat

		recovery of protected species • Critical Habitat status • Status of key prey species populations	interactions • Change in prey populations	
Habitat	• Gear type • Habitat protection (closed areas) • Prey availability • Fishing effort • Fishing capacity	• Existing FMP regulations • Other actions to protect habitat, EFH, HAPC, protected species or fishing effort (closed areas and gear restrictions/ modifications) • Fishing gear impacts to habitat • Non-fishing impacts to habitat (pollution/habitat alteration and destruction, etc.) • Status of key prey species populations associated with EFH	• Habitat/gear interactions • Benthic productivity • Benthic community complexity/diversity • Bottom micro-structure • Change in water quality • Prey populations and availability	• Area of habitat/EFH/HAPC impacted/protected • Habitat productivity, complexity and/or diversity • Bottom micro-structure • Water quality
Human Communities	• Fishing effort • Fishing capacity • Fishing allocation • Protected species (closed areas) • Habitat protection (closed areas) • Gear type/mesh size • Size limits • Reporting requirements • Safety • Enforcement • Fishery administration • Property use	• Existing socio-economic conditions of ports, communities, minority/low income populations • Restrictions of all FMPs whose regulations overlap in time or geography with the proposed action • FMP costs to fishers/associated industries • FMP Reporting requirements of this FMP • Relative Safety of fishing practices under FMPs • Enforcement requirements of FMPs	• Revenue of Fishers/associated industries • Costs of Fishers/associated industries • Jobs of Fishers/associated industries • Changes in general economic/social health of Region's Ports, Communities, and minority/low income populations • >Required reporting • in safety • < in Enforcement capability • in fisherman or community quality of life	• $ gained or lost to fishers/ associated industries • Jobs gained or lost to fishers/ associated industries • $/time lost to added/reduced from additional reporting requirements • projected lives lost due to < safety • costs/ efficiencies of enforcement • lost development opportunities • in social cost such as health, crime, domestic or substance abuse

Fishing Gear Effects on Habitat and EFH – A Special Issue

The direct and indirect effects of the gear types utilized within FMPs for managed (target) species are a continuing issue, particularly relative to such effects on various bottom habitats (EFH). A recent National Research Council book partially addressed this topic (Committee on Ecosystem Effects of Fishing, 2002). Further, a comprehensive report on this subject was released in 2004 (Stevenson, et al., 2004). Chapter 3 in this report, hereafter referred to as the "Stevenson Report," summarizes the fishing gear and practices utilized in the Northeast Region of NOAA Fisheries Service. Four broad gear types are also addressed in Chapter 3 – bottom-tending mobile gear, bottom-tending static gear, pelagic gear, and other gear. Chapter 4 highlights the geographic distribution of fishing activity by gear type.

Chapter 5 of the "Stevenson Report" contains an extensive review of available literature on the effects of various gear types. This information would be particularly useful when addressing cumulative effects from geographically overlapping fisheries on common fisheries resources, habitats, and protected species. A total of 18 summary tables are included by gear types and related substrate habitats. One example summarizes the effects of otter trawls on sand substrate habitat (Stevenson, et al., 2004, Table 5.5 on pp. 114-115). The findings from a total of 14 references (12 from peer-reviewed literature) are summarized in the report's Table 5.5 relative to study location, water depth, sediment characteristics, effects, natural recovery from the effects, and the study approach. The effects information could be used as the basis for qualitative predictions of direct and indirect effects as well as contributions to cumulative effects.

Box SB-1: Existing Conditions/Status/Trends for the Selected VECs (Related to Affected Environment Section)

Historical and current conditions for each VEC would typically be addressed in Affected Environment sections of EISs and EAs (Canter, 2008). Further, CEA studies should also include temporal trends and pertinent spatial areas in the conditions for each VEC. Box SB-1 represents a foundational block in the two-component process. Further, the included information should represent the accomplishment of Steps 5 to 7 of the CEQ's 11-step CEA process.

In addition to the detailed descriptions of the conditions, in a CEA study it is important to summarize the Affected Environment conditions for each of the selected VECs (and their indicators). Such a summary could be included at the end of the Affected Environment section. A useful approach would be to include a summary table supported by narrative descriptions of the included information. To illustrate, Table 1 above could be modified as follows:

- Maintain the left column (Affected Resource of Concern) with the pertinent study VECs included as rows.

- Remove columns two through five and replace with the following four columns, in order, as follows: Historical Conditions; Current Conditions; Possible Future Conditions (based on historical conditions, current status, and identified trends); and Implications of Conditions Relative to Past, Current, and Future Sustainability of the VEC. Then, include summary descriptive and/or quantitative information in each cell in the table, and discuss the implications of the findings.

<u>Boxes SB-2 and SB-3: Other Past, Present, and Reasonably Foreseeable Future Actions (Includes FMP/ESA/MMPA Actions and Non-Fishing Actions)</u>

As inferred by the cumulative effects definition above, the effects of other actions on the selected VECs should be identified and then combined with the incremental effects (i.e., direct/indirect effects) of the proposed action and alternatives. The combination of such effects could be additive, synergistic, or countervieling. The other actions could encompass a variety of proponents and they should be considered relative to a study-specific time horizon (past, present, and future).The following approach can be taken to identify and classify other actions (Step 4 in the CEQ's 11-step CEA process):

- Identify other actions within the identified spatial boundaries of the impact study which could contribute effects to the selected VECs (the boundaries can vary with each VEC).

- Classify the other actions as appropriate. For example, a fundamental grouping could be fishing actions and non-fishing actions. The former grouping should include, as appropriate, the original FMP and any subsequent amendments, other relevant FMPs and their amendments, actions related to protected species that could have arisen from meeting various requirements of the ESA or MMPA, and actions related to the EFH requirements within the MSA. Information sources for past, present, and future Federal actions include historical and current EISs or EAs from the Region, as well as contacts with relevant divisions (Sustainable Fisheries, Habitat Conservation, and Protected Resources). Information sources for non-Federal fishing actions could include state agencies involved in state-managed coastal and marine fisheries, fisheries commissions, state and regional coastal zone commissions, as well as several Federal and state agencies with responsibilities for permit programs. Examples of such permitting agencies include the U.S. Army Corps of Engineers, the USEPA, state water quality or water resources agencies, and coastal zone commissions.

- Once other actions are classified, they can also be grouped by their temporal characteristics (past, present, and future actions). In fact, this type of information can be collected for fishing actions via Regional contacts within NMFS, contacts with the Fishery Management Councils, and contacts with state or commission programs. Information sources for non-fishing actions would be the same as noted above.

- A special type of other actions are called reasonably foreseeable future actions (RFFAs). The key question is … what makes a potential future action reasonably foreseeable? A review of 40 court cases wherein reasonably foreseeable was an issue provided instruction on how to answer this question (Rumrill and Canter, 1997). Specifically, one answer is that the identified future action must be within an overall approved plan or a separately approved plan. Another answer was that the future action was beyond mere speculation (this means that some planning has been accomplished, and there is a reasonable likelihood of occurrence). The same information sources as noted above could be utilized to identify RFFAs for both fishing actions and non-fishing actions.

- Another special issue related to other actions is associated with the extent of analysis that might be required. In June 2005, CEQ issued guidance on the consideration of past actions in cumulative effects analysis (Connaughton, 2005). This guidance addressed the extent to which information should be assembled on past actions which have contributed to cumulative effects on specific VECs. The guidance suggests that a key question is related to whether or not specific information on the effects of past actions will inform the current decision. If the answer is yes, a more thorough analysis would be required. If the answer is no, only summary information would be needed.

Following the initial identification and classification of other actions, attention must be directed toward the effects of these actions on the selected VECs. If no information is available to suggest that they would have effects, then it is possible to eliminate other actions from further analysis. Information from other EISs and EAs on fishing actions could be used to delineate potential effects on selected VECs. Further, the earlier described Stevenson Report has useful information on the effects of gear types on EFH (Stevenson, et al., 2004).

Non-Fishing Effects – A Special Issue

Relative to “non-fishing activities,” a summary report which includes generic information on the impacts of non-fishing activities on EFH is available (Hanson, et al., 2003). This report could be a useful information source for CEAs conducted in any Region of NOAA Fisheries Service. Key definitions and concepts for EFH were included in the 1996 MSA, and extended as part of the

2007 reauthorization of the MSA. Two key definitions related to these impacts are as follows:

- EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (National Marine Fisheries Service, January 12, 2007). *Waters* include aquatic areas and their associated physical, chemical, and biological properties. *Substrate* includes sediment underlying the waters. *Necessary* means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. *Spawning, breeding, feeding, or growth to maturity* covers all habitat types utilized by a species throughout its life cycle (Hanson, et al., 2003, p. 1; and Office of Habitat Conservation, 1999).

- *Adverse effect* means any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (U.S. Department of Commerce, 2007).

Non-fishing activities associated with terrestrial or aquatic environments in nearby riverine, estuarine, and marine ecosystems can contribute to cumulative effects on the quality or quantity of EFH. Compiled effects information from numerous USEPA, USFWS, and NOAA Fisheries Service reports, along with peer-reviewed literature, was assembled by Hanson, et al. (2003) as a reference document on typical adverse impacts on EFH, and potential conservation measures which could be used to mitigate such measures. The non-fishing activities addressed included the following (Hanson, et al., 2003):

- Upland activities – nonpoint source pollution (agricultural/nursery runoff, silviculture/timber harvest, and pesticide application), urban and suburban development, and road building and maintenance.

- Riverine activities – mining (mineral mining and sand and gravel mining), debris removal (organic debris and inorganic debris), dam operation, and commercial and domestic water use.

- Estuarine activities – dredging, disposal/landfills (disposal of dredged material and fill material), vessel operations (including waterborne transportation and navigation), introduction of exotic species, pile installation and removal (pile driving and pile removal), overwater structures, flood control and shoreline protection, water control structures, log transfer facilities and in-water log storage, installation of linear crossings (utility lines, cables, and pipelines), and commercial utilization of habitat.

- Coastal and marine activities – point source discharges, fish processing wastes (shoreside and vessel operation), water intake structures and discharge plumes, oil and gas operations (exploration, development, and production), habitat restoration and enhancement, and marine mining.

The information in the Hanson, et al. (2003) report could be utilized to construct impact matrices (connector tables) and develop collaborative mitigation strategies for reducing the contributions of non-fishing activities to cumulative effects on EFH. Such strategies could enhance the sustainability of managed fisheries resources and protected species. Further, it should be recognized that still other non-fishing actions may need to be addressed. Examples of societal actions which might need to be addressed include beach renourishment, harbor dredging, liquefied natural gas terminals, wind farms, and shipping and transport. Climate change, which is related to both natural and societal-induced causes, is increasing in importance in certain regions.

Connecting Actions to Effects on VECs

Following the identification of pertinent other actions, as well as the effects they could contribute to the selected VECs, it is necessary to demonstrate their connections to the VECs or selected indicators. One method for doing so is via the use of matrix tables. Tables 2 through 4 provide examples of the construction of such tables and of the type of information which should be included therein (Morton and Tomey, 2006). The titles of these three tables are self-explanatory:

- Table 2: Example Impacts of Past and Present Fishing Actions on Resources (VECs) Identified for FMP or Other Management Action – note the utilized codes in the first column for past (P) and present (Pr) actions; further, the fishery management actions are numbered.

- Table 3: Example Impacts of Reasonably Foreseeable Future Fishing Actions on Resources (VECs) Identified for FMP or Other Management Action. – note the code in the first column for reasonably foreseeable future actions (RFFA); further, the MSA actions are numbered.

Table 2. Example Impacts of Past and Present Fishing Actions on Resources Identified for FMP or Other Management Action (Morton and Tomey, 2006, p. I-17)

Action	Description	Target Species	Non-Target Species	Protected Species (Seabird, Sea Turtles, Seals and Dolphins)	Physical Environment and EFH	Fishery Businesses and Communities
FISHERY MANAGEMENT ACTIONS						
Management Action # 1 Implementation of FMP (1991) [P, Pr]	Implemented limited access fishing permits; established a Total Allowable Catch (TAC) quota	**Positive** -- Reduced fishing mortality by a reduction in catches by 20%	**Positive** -- Reduced bycatch by 10%	**Positive** – Reduction in fishing effort resulted in fewer interactions with Sea Turtles, Seals and Dolphins; Neutral on Seabirds	**Positive** – Reduction in fishing effort resulted in less time the gear in contact with the bottom, which reduced negative impact to benthos and bottom structure	**Negative** -- Reduced fishing effort reduced revenues in 12 communities; Havenport was more affected than other ports since it was highly dependant upon this fishery
Management Action # 2 (1995) [P, Pr]	Lowered TAC by an additional 15%	**Positive** - Reduced fishing mortality by a reduction in catches by 15%	**Positive** -- Reduced bycatch by 8%	**Positive** – Reduced fishing effort results in fewer interactions with Sea Turtles, Seals and Dolphins; Neutral on Seabirds	**Positive** – Reduction in fishing effort resulted in less time the gear in contact with bottom, which reduced negative impact to benthos and bottom structure	**Negative** -- Reduced fishing effort resulted in reduced revenues by 15%; Havenport was more affected
Management Action # 3 (from another but related fishery) (2001) [P, Pr]	Gear modification required in related fishery to reduce bycatch of target species	**Positive** -- Reduced fishing mortality by a reduction in catches of Target Species by 8%	**Neutral** – Catch of Non-target species not affected	**Positive** – Modified gear reduced interaction with small marine mammals and Sea Turtles as compared to old gear; Neutral on Seabirds	**Neutral** – No change in fishing effort and gear operation; no change in impacts to benthos and bottom structure	**Low Negative** – Reduced catches resulted in reduced revenues plus cost of modified gear
Net Impact Summary P = Past Action Pr = Present Action		**Positive – Overall a 43% reduction in fishing mortality of Target Species over 10 years has increased stock biomass**	**Positive – Reduction in fishing effort has reduced catches of Non-target Species from Management Actions # 1 and 2 has thus increased stock biomass**	**Positive – Reduction of interactions has reduced potential for injuries or mortality for Sea Turtles and the marine mammals; Neutral on Seabirds**	**Positive – Overall reduction of bottom contact time from Management Actions #1 and 2 has reduced adverse effects to benthos and bottom structure in managed offshore areas**	**Negative -- Reduction in revenue over last 14 years; Havenport has more adverse economic effects than other ports**

Table 3. Example Impacts of Reasonably Foreseeable Future Fishing Actions on Resources Identified for FMP or Management Action (Morton and Tomey, 2006, p. I-18)

Action	Description	Target Species	Non-Target Species	Protected Species (Seabird, Sea Turtles, Seals and Dolphins)	Physical Environment and EFH	Fishery Businesses and Communities
MSA ACTIONS						
Fishery Management Action # 4 RFFA	Would establish closed areas to protect spawning habitat	**Positive** – Proposed closure expected to increase spawning success	**Low Positive** – Closures expected have only minor benefits to Non-Target Species B since it is not prominent in closure area	**Positive** – Closure area would reduce interaction with 2 species of dolphin that occur in close area	**Positive** – Spawning habitat would be protected within closure area	**Neutral/Negative** – Closure area may reduce landings of target species, however the loss may be offset by fishing in other areas
Fishery Management Action # 5 – Non-Target Species FMP RFFA	Would establish seasonal restrictions on fishing to reduce fishing mortality	**Positive** – Incidental catch of Target Species would be reduced	**Positive** – Fishing effort for Non-target Species would be reduced	**Positive** -- Negative impacts to turtles in the area would be reduced during seasonal fishing restriction	**Positive** – Proposed seasonal restriction would reduce bottom contact time and thus benefits habitat	**Negative** – Proposed seasonal restriction is projected to reduce revenues.
ESA/MMPA Actions						
ESA Management Action RFFA	Proposed gear requirement to reduce Endangered seabird interaction	**Neutral** – Proposed gear would not change catches of Target species	**Neutral** – Proposed gear would not change catches of Non-target species	**Positive**- New gear would reduce entrapment of Endangered Seabird species and other seabird species	**Neutral** – The proposed new gear would not change habitat impacts	**Low negative** – Cost of new gear would be small financial burden for the first year of implementation
MMPA Management Action RFFA	Proposed rule would close area seasonally to certain gears to protect seals and dolphins	**Low Positive** – proposed seasonal closure would reduce overall catches but fishing effort would be shifted to areas outside seasonal closure	**Low Positive** – Catches of non-target species in the closure area are expected to be reduced	**Positive** – Reduced interactions of seals and dolphin in closed areas; Neutral to 1 Endangered Seabird species since it does not occur in closed area	**Low Positive** – Seasonal reduction of fishing effort in closed area would reduce impact to benthos	**Low Negative** – Revenues are expected to be slightly reduced by the concomitant reduction in catches.
Net Impact Summary		**Positive – Fishery Management Actions # 4, 5 and MMPA**	**Low positive to Positive – Fishery Management Actions # 4, 5**	**Positive – Proposed gear restrictions in ESA Action would reduce interactions with the Endangered Seabird**	**Low Positive to Positive – Proposed closures, restrictions and reductions if fishing effort would**	**Negative – Expected reduction in revenues from proposed actions would combine with required new gear**

		Action would likely continue to improve stock biomass	**and MMPA Action would reduce catches of Non-target species and thus increase stock biomass**	**species and other seabird species; Fishery and MMPA area closures would reduce interactions with Sea Turtles and the marine mammals; 2 species of dolphins would particularly benefit**	**have positive effects on offshore habitat**	**costs; communities already economically burdened**

Table 4. Example Impacts of Past, Present, and Reasonably Foreseeable Future Non-Fishing Actions on Resources Identified for FMP or Management Action (Morton and Tomey, 2006, pp. I-19 and I-20)

Action	Description	Target Species	Non-Target Species	Protected Species (Seabirds, Sea Turtles, Seals and Dolphins)	Physical Environment and EFH	Fishery Businesses and Communities
Vessel operations, marine transportation P, Pr, RFFA	Expansion of port facilities, vessel operations and recreational marinas	**No Impact at Site**	**No Impact at Site**	**Negative at Site** – inshore species impacted by reduced water quality and haul out activity	**Potentially Negative Inshore** – may lead to destruction of habitat	**Potentially Negative --** if loss of fishing opportunities occur
Beach nourishment; Dredge and Fill activities; Offshore Mining P, Pr, RFFA	Placement of sand to nourish beach, fill shorelines. Offshore mining of sand for beaches	**Negative at Site** – entrainment, sedimentation and turbidity impacts to fish in area in and around dredge borrow or disposal site; May displace fish, remove benthic prey and increase mortality of early life stages	**Negative at Site** – entrainment, sedimentation and turbidity impacts to fish in area in and around dredge, borrow or disposal site; May displace fish, remove benthic prey and increase mortality of early life stages	**Negative at Site** – dredge and mining activity increases noise and reduces water quality; Turtles susceptible to impacts from beach nourishment	**Negative at Site** – may lead to destruction of habitat in and around dredge, borrow or disposal site; May result in burial of structures that serve as foraging or shelter sites	**Negative at Site** – potential loss of fishing opportunities. **Positive at Site** – restoration of an eroding shore may protect or restore recreational beaches
Pollution/water quality P, Pr, RFFA	Land runoff, precipitation, atmospheric deposition, seepage, or hydrologic modification; Point-source and unpermitted discharges	**Negative at Site** – impacts primarily inshore	**Negative at Site** – impact to species located inshore	**Negative at Site** – degraded water quality due to toxics and nutrient loading; chronic/acute toxicity to inshore species exposed to discharged toxics; impaired biological food chain	**Negative at Site** – impacts primarily inshore, leads to destruction of habitat and EFH and degradation of nearshore water quality	**Negative at Site** – potential loss of fishing opportunities, human health issues
Offshore Wind Farm Energy Project	Construction and operation of wind	**Potentially Negative at Site –** Short term water quality impacts	**Potentially Negative at Site –** Short term water quality impacts	**Potentially Negative at Site –** Short term water	**Negative at Site –** Localized disturbance of habitat during construction	**Potentially Negative –** Certain Fishing gear may

RFFA	turbine structures in specified area	during construction could adversely affect target species in the immediate area	during construction could adversely affect non-target species in the immediate area	quality impacts during construction could adversely affect protected species in the immediate area	and localized loss in the long term	be hindered in the area between the turbine towers. Fishing effort could shift to other adjacent areas.
Net Impact Summary		**Low Negative overall -- Potentially negative Impacts in the area immediately around the site; Minor overall adverse effects to target species since the localized nature of the sites result in a limited exposure to the largely unaffected offshore population**	**Low Negative overall -- Potentially negative Impacts in the area immediately around the site; Minor overall adverse effects to non-target species since the localized nature of the sites result in a limited exposure to the largely unaffected offshore population**	**Low Negative overall -- Potentially negative Impacts in the area immediately around the site; Minor overall adverse effects to protected species since the localized nature of the sites result in a limited exposure to the largely unaffected offshore population**	**Low Negative overall -- Negative impacts from disturbance and construction activities in the area immediately around the project site. Given the wide distribution of the affected species, minor overall negative effects to offshore habitat are anticipated since the affected areas are localized to the sites and are a small percentage of the total unaffected habitat; impacts to compromised inshore water quality planktonic life stages are unknown but likely minor due to the transient exposure**	**Low Negative to Negative -- (if fishing activities are precluded from the affected areas)**

P = Past Action

Pr = Present Action

RFFA = Reasonably Foreseeable Future Action

- Table 4: Example Impacts of Past, Present, and Reasonably Foreseeable Future Non-Fishing Actions on Resources (VECs) Identified for FMP or Other Management Action – note the utilized codes (P, Pr, and RFFA) for the non-fishing actions.

It should be noted that these three tables include impacts described in relation to characteristics such as low positive, positive, neutral, low negative, and negative impacts. Each of these terms should be clearly defined and the rationale utilized should be delineated in the supporting text. Further, each table includes a net impact summary for each selected VEC. These tables contain key building blocks for defining the CEA Baseline (see Figure 1 above).These types of tables could be incorporated in either the main body or supporting appendices in EISs or EAs. Finally, to relate Boxes SB-2 and SB-3 to CEQ's 11-step CEA process, it is observed that they represent the accomplishment of Steps 4 and 8.

Box SB-4: Summarizing the CEA Baseline

As inferred in Figure 1, the CEA Baseline (Box SB-4) represents a composite of the findings related to Boxes SB-1, SB-2, and SB-3. As described above, a summary of the findings related to the Affected Environment could be incorporated in a matrix table (not included herein) with a similar structure to Table 1. In addition, the net impact summary portions of Tables 2 throughout 4 could be added to the summary of the Affected Environment, thus an overall summary table for Box SB-4 could be assembled. Box SB-4 and its summary table would then include information related to Steps 1 through 8 of the 11-step CEA process of CEQ. This concept is demonstrated in Table 6 below. Further, it should be noted Box SB-4 represents a key building block in the Impact Analysis (IA) component of the two-component process.

Box IA-2: Impact Analysis – Connecting the Incremental Impacts with the CEA Baseline

As shown in Figure 1, Impact Analysis involves connecting the direct and indirect impacts (incremental impacts) of the preferred and other alternatives with the CEA Baseline. At this point in the CEA study, each of the building blocks comprising the CEA Baseline should have been completed, as would the building block on direct/indirect impacts. Further, each building block should have been structured around the selected VECs and their related indicators. To illustrate, Table 5 depicts an example of the direct and indirect impacts (effects) of three fishery management alternatives and three additional management measures related to implementing a vessel monitoring system (VMS) (Morton and Tomey, 2006, pp. I-21 and I-22). As can be seen, the first row for the two groups of three

Table 5. Example Impacts of the Proposed Action and Alternatives on the Affected Resources Identified for Consideration (Morton and Tomey, 2006, pp. I-21 and I-22)

	Target Species	Non-Target Species	Protected Species (Seabirds, Sea Turtles, Seals and Dolphins)	Physical Environment and EFH	Fishing Businesses and Communities
Fishery Management Alternatives					
No Action (Alternative 1)	**Status Quo** – as described in the Affected Environment Section of the EIS; Latest stock assessment indicates stock will not rebuild for 15 years	**Status Quo** -- as described in the Affected Environment Section of the EIS	**Status Quo** -- as described in the Affected Environment Section of the EIS	**Status Quo** -- as described in the Affected Environment Section of the EIS	**Status Quo** -- as described in the Affected Environment Section of the EIS
Alternative 2 Lower TAC by an additional 15 %	**Positive** – Would reduce fishing mortality by reducing catches by 15%; Rebuilding goals will be met in 10 years.	**Positive** – Would reduce bycatch of species B by 10%	**Positive** – Decrease in fishing effort would result in fewer interactions with protected species	**Positive** – Decrease in fishing effort and bottom contact time would reduce negative impact to benthos and bottom structure	**Negative** -- Reduced fishing effort would result in reduced revenues in comparison to No Action: Havenport would be more affected than other ports since 80% of vessels depend on this fishery
Alternative 3 Lower TAC by 20 %	**Positive** – Would reduce fishing mortality by reducing catches by 20%; Rebuilding goals will be met in 8 years	**Positive** – Would reduced bycatch of Non-target species by 13% ; Slightly more positive than alternative 2 due to lower catches	**Positive** – Decrease in fishing effort decreases the potential for interaction with protected species	**Positive** – Decrease in fishing effort and bottom contact time would reduce negative impact to benthos and bottom structure	**Negative** – Reduction in fishing effort as compared to Alternative 2 would result in greater reduced revenues; Havenport would be more affected than other ports since 80% of vessels depend on this fishery
Additional Management Measures					
Implement Vessel Monitoring System					
No Action: No VMS	**Status Quo** -- no monitoring reduces real time oversight of fishing effort	**Status Quo**	**Status Quo**	**Status Quo**	**Status Quo --** assumes no monitoring, meaning no real time oversight of fishing effort
Option 1: VMS for all Vessels	**Positive** - No direct effects expected;	**Neutral** -- No effects	**Neutral** -- No effects	**Neutral** -- No effects	**Low Negative** -- Initial cost of $1500 - $6,000 per vessel

	Preventing overfishing would be an indirect positive effect of improved quota monitoring				
Option 2: VMS for Vessels over 50 feet	**Positive** - Same as above—slightly less beneficial since few vessels are monitored	**Neutral** -- No effects	**Neutral** -- No effects	**Neutral** -- No effects	**Low Negative** - Less negative than Option 1; Cost only to larger vessels

alternatives relates to the status quo (current conditions) for the five VECs. Referrals are typically made to the Affected Environment section of the EIS (or EA). The impacts are described as being positive, neutral, negative, or low negative.

The connections between the incremental impact and the CEA baseline can be demonstrated via the development of a summary matrix table for each VEC. To illustrate, Table 6 is an example of a summary table for one VEC – managed (target) species (Morton and Tomey, 2006). As was the case for Table 5, example management alternatives and additional mitigation measures are shown in the first column. The second column summarizes the incremental impacts of what will become the preferred action and its alternatives. Note that this information should be extracted from Table 5, as well as the narrative discussion of the direct and indirect effects. The third column is developed from the Affected Environment section; and if, as noted above, a summary matrix table had been prepared at the end of this section, its contents could be utilized. The fourth through the sixth columns represent the impacts on the selected VEC that would occur from other actions (past, present, and future fishing actions; as well as past, present, and future non-fishing actions). Again, the cells should be populated with net impact summary information from Tables 2 through 4, respectively. Finally, the seventh column reflects the total cumulative effects on this VEC. Again, explanations should be provided for the impact terminology (low positive, positive, and high positive) which is utilized.

In a structure similar to that for Table 6, additional summary tables could be constructed for the other selected VECs. Examples of tables which could be utilized for four other VECs (non-target species, protected species, physical environment and EFH, and fishing businesses and communities) are included as Tables I-7 through I-10 in the Morton and Tomey report (2006).

The matrix-based approach for integrating cumulative effects information, as shown in Figure 1 and described above, represents one approach for CEA. This approach does provide a documentable process and is indicative that a hard look was taken relative to cumulative effects within an EIS. Conversely, for EAs, a more simplified process might be useful. Simplifications could result from the appropriate identification of fewer direct and indirect effects from the alternatives, fewer VECs, fewer other actions, and fewer cumulative effects concerns. In fact, descriptive narrative could possibly be used in EAs in lieu of a matrix and narrative approach.

Finally, there are still other ways to address cumulative effects rather than the building block approach of Figure 1 and the use of matrix tables. For example, some NOAA Fisheries Service Regional Offices directly address the 11-steps of CEQ's process and provide narrative descriptions of the CEA.

Table 6. Example Summary of Cumulative Impacts on Target Species (Morton and Tomey, 2006, pp. I-23 and I-24)

	Direct and Indirect Impacts of Proposed Action **Information here will come from TABLE 5 and Env Consequences Section of EIS**	**Existing Conditions/Trends Of Affected Resource** **From Affected Environment Section of EIS**	**Past to Present Fishing Actions** **From Summary Cell info from TABLE 2 and Affected Environment Section of EIS**	**Impacts from Reasonably Foreseeable Future (RFFA) Fishing Actions** **From Summary Cell info from TABLE 3 and narrative from Cum Effects Section of EIS**	**Impacts from Past, Present and Reasonably Foreseeable Future Non-Fishing Actions** **Summary info from TABLE 4 and narrative from Affected Environment and/or Cum Effects Section of EIS**	**Cumulative Impacts** **COMBINE impacts of previous columns; combined impacts can be additive, negligible or countervailing and characterized as positive, negative or neutral**
Management Alternatives						
No Action Alternative 1	**Status Quo** – Status Quo as described in the Affected Environment Section of the EIS	**Negative** - Species A is overfished with a projected slow recovery under existing regulations; stock is currently projected to rebuild in 15 years	**Positive** – Overall a 43% reduction in catches of Target Species over 10 years has reduced fishing mortality and increased stock biomass	**Positive –** Fishery Management Actions # 4, 5 and MMPA Action would likely continue to improve stock biomass	**Low Negative** - Potentially negative Impacts in the area immediately around the site; Minor overall adverse effects to target species since the localized nature of the sites result in a limited exposure to the largely unaffected offshore population	**Low positive** – Stock would not rebuild in 10 year period but likely less than 15 years
Alternative 2	**Positive** – Would reduce catches by 15%; Rebuilding goals would be met in 10 years.					**Positive** – Stock biomass would increase more quickly that No Action and would rebuild in 10 years
Alternative 3	**Positive** – Would reduce catches by 20%; Rebuilding goals would be met in 8 years					**Positive to High Positive** -- More positive than Alternative 2; Further reduced catches would accelerate stock rebuilding and provide greater assurance of meeting the rebuilding goal
Additional Management Measures						
Implement Vessel Monitoring System						
No Action	**Status Quo** -- no monitoring would mean no real time	Same as above	Same as above	Same as above	Same as above	**Low Positive** - Past, Present and RFFA reduction in catches would continue to increase stock biomass over time

	oversight of fishing effort					without the benefit of real time monitoring
Option 1	**Positive** - No direct effects expected; Preventing overfishing would be an indirect positive effect of improved quota monitoring					**Positive** -- Past, Present and RFFA reductions in catches would continue to increase stock biomass over time; real time monitoring would enhance stock assessments to provide better response to biomass changes
Option 2	**Positive** - Same as above—slightly less beneficial since few vessels are monitored					**Positive** – Impacts would be the same as Option 1; with slightly less sensitivity to biomass changes because fewer vessels would be monitored

Additional information on these other examples can be procured from Internet searching of NEPA compliance documents produced by all six Regional Offices.

<u>Cumulative Effects Evaluation (Significance, Monitoring, and Adaptive Management)</u>

The final feature of a CEA study involves the evaluation of the anticipated cumulative effects (Box IA-2 shown in Figure 1). Evaluation encompasses the determination of the significance of the identified cumulative effects. Criteria for such determinations are referenced or described earlier; such criteria are from CEQ (40 CFR 1508.27) and NOAA (Section 6.02 of NAO 216-6). Several of the latter criteria appropriately emphasize the sustainability of VECs. Step 9 (b) in CEQ's 11-step process highlights significance determinations.

Steps 10 and 11 of CEQ's process emphasize mitigation, monitoring, and adaptive management. Mitigation of significant negative (adverse) cumulative effects will need to be considered in EISs (Step 10). In many cases, management measures incorporated within the alternatives are already providing mitigation choices. Further, it may be appropriate to extend mitigation beyond the incremental impacts of the preferred and other alternatives. Such extensions could encompass both intra-agency collaboration within NOAA Fisheries Service, and similar collaboration with other Federal and state agencies and commissions (U.S. Environmental Protection Agency, 1999). An example CEA study which used the concept of the two-component process was the Final Supplemental EIS on Amendment 9 to the Atlantic mackerel, squid, and butterfish FMP (Mid-Atlantic Fishery Management Council…, 2008). This document could be downloaded from the Internet and used as a case study.

Monitoring of indicators of significant adverse cumulative effects may also be useful (Step 11). A discussion of detailed planning for such monitoring, which could be envisioned as an add-on to traditional fishery monitoring programs, is beyond the scope of this paper. However, a practical information source for monitoring planning and implementation is Marcus (1979). When such monitoring is done, the results can be used to reduce a variety of uncertainties related to the magnitude of cumulative effects, the key actions influencing such effects, and the relationships between cumulative effects and the sustainability of selected VECs. Again, a detailed discussion of adaptive management which could be responsive to monitoring findings is beyond the scope of this paper. However, a reference document relating adaptive management principles to fisheries and protected species is available (Canter, 2007). This document is consistent with information in the CEQ Task Force report on modernizing NEPA implementation and practice in the United States (Council on Environmental Quality, 2003).

PRESENTATION OF CEA FINDINGS IN EISs OR EAs

The CEQ's 1997 guidance on CEA did not specifically address the placement of the resultant information in NEPA compliance documents. As a result, Federal agencies typically include the CEA findings within the last subsection of the Environmental Consequences sections of EISs or EAs. Affected Environment-related information is typically included in that respective section. To place this typical approach in context, only the information from the Box SB-1 would be placed in the Affected Environment section. This approach would also typically involve the placement of the information from the other five boxes in Figure 1 within the last subsection of the Environmental Consequences section.

An alternative to the typical approach can be termed the stand-alone approach (Morton and Tomey, 2006). It would generally consist of a separate Cumulative Effects section (or chapter) which would follow the Environmental Consequences section (or chapter) (this section could focus on direct and indirect impacts of the alternatives only). These results could be summarized in the new Cumulative Effects section (chapter). While the stand-alone approach is not used as frequently as the typical approach, it could certainly be considered for CEA information summarization and communication for NEPA compliance documents that are programmatic in coverage.

Another fundamental issue related to the presentation of CEA findings in NEPA compliance documents is whether to use a narrative presentation only (the process and findings of the study are descriptively discussed in paragraph formats) or a narrative and tabular presentation. The narrative approach could be used for EAs, while the combined one would be appropriate for EISs. The latter presentation incorporates tables (matrix or connector tables), figures, and maps to support the narrative presentation. If the latter approach is used, each table, matrix, figure, and map should be sufficiently explained so that the reader will understand the connections between the narrative and the visual aid materials.

FINAL CONSIDERATIONS – TWO SPECIAL CHALLENGES

The traditional approach for marine fisheries impact studies has been to focus on either single species or multiple species addressed together and to examine potential direct and indirect effects of management measures on their stock status. Recently, increasing attention has also been directed toward ecosystem-based management of fisheries (Ecosystem Principles Advisory Panel, 1999; Ecosystem Approach Task Force, 2003; Halpern, et al., 2008; and Committee on Ecosystem Effects of Fishing, 2006). If an ecosystem-based approach is to be used, it may be desirable to address the key interrelations and dynamics within the different ecosystems identified in the study area. Further, ecosystem-based fisheries management recognizes that fishing can alter a wide range of biological interactions, causing changes in predator-prey relationships, cascading effects mediated through food-web interactions, effects on protected resources, and the loss or degradation of essential fish habitats. These impacts, along with natural fluctuations in the physical state of marine waters and resources can interact to intensify fishing impacts beyond targeted species. Further, fishing is also generally size and species selective; thus, it could lead to changes in the genetic structure and age composition of fished stocks, as well as decrease the diversity of marine communities (Committee on Ecosystem Effects of Fishing, 2006, p. 2). These newer effects-related challenges could be incorporated in the Environmental Consequences chapters (sections) of EISs, including sub-sections on CEA, or in separate chapters (or sections) addressing cumulative effects.

An additional challenge for consideration in CEA is associated with how the common effects from a variety of actions will accumulate. The most frequently used perspective is that the common effects are additive. However, the need to consider interactive or multiplicative effects relative to marine resources has been noted (Halpern, et al., 2008, p. 204). A further consideration is related to the identification of dominant stressors (or major contributors to common effects). It has been suggested that the relative dominance of stressors is a function of five attributes – spatial scale, taxonomic scale (species to entire community), frequency of the activity, and the resistance and recovery time of the ecosystem to the activity. Stressors that rank high in several or all of these five vulnerability attributes would emerge as dominant stressors. In contrast, those that do not typically rank as high in the attributes would be less important (Halpern, et al., 2008, p. 206). Accordingly, consideration of how effects accumulate, as well as their attributes, represents a special challenge in the marine environment.

CONCLUSIONS

A practical and cost-effective marine fisheries-related, two-component CEA process is described herein. The process is compliant with the requirements of CEQ’s NEPA regulations and NOAA Fisheries Service supporting regulations. Further, it incorporates CEQ’s 11-step CEA approach. The process includes two components – Scoping and Baseline, and Impact Analysis. Each component is comprised of requisite building blocks. For example, Scoping and Baseline integrates affected environment information with effects information from other non-fishing and fishing actions to define the CEA Baseline. The Impact Analysis component integrates the CEA Baseline findings with the direct and indirect impacts of alternatives to determine cumulative effects. The identified cumulative effects are then evaluated relative to their significance, and potential follow-on activities such as monitoring and adaptive management can be considered. Practical approaches are described for each building block, and information is included on the development of matrix tables which can be used to plan the CEA study and summarize the findings.

Key lessons related to the development of connector matrices (matrix tables) for CEA for marine fisheries management include the following:

- Multiple matrices will be needed to address the contributions of direct/indirect effects of proposed actions and other actions (past, present, and future) on pertinent study VECs. Such matrices can be useful for both the conduction and summarization of a CEA study. The summary information in the matrix cells should be supported by descriptive information in the text of the pertinent EIS or EA.

- The use of matrices can provide a consistent approach for both identifying and evaluating cumulative effects. Further, the rows and columns in specific matrices can be modified to meet study needs. For example, the consequences of "natural events" such as climate change can be examined in relation to the Affected Environment. Accordingly, a column entitled climate change could be added to either Table 1 or a specific table summarizing the environmental conditions (past, present, and future) of the pertinent study VECs.

- The net impact summary information in individual matrix tables can inform decision makers and the decision making process.

- When effects codes are used in matrix tables; e.g., positive, neutral, negative, etc., the codes should be clearly defined in the text and, if appropriate, in footnotes to the tables.

- The two-component process provides the basis for a "hard look" (a phrase used in USA court decisions as a test of NEPA documentation adequacy), and it is in compliance with case law findings which are directly or indirectly related to CEA (Atkinson, et al., 2006; and Smith, 2006).

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