

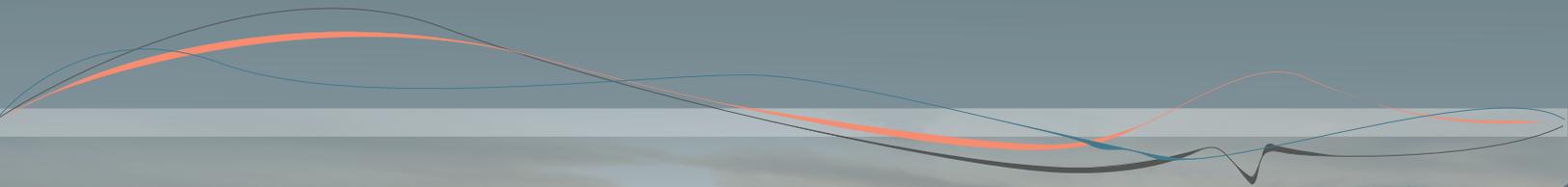


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PEER REVIEW

*Developing Successful Scientific and Technical Review Processes
to Advance Science in Marine and Coastal Decision-making*



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About this Document

This reference was developed by California Ocean Science Trust to guide external partners through our process of designing and implementing effective peer reviews of scientific and technical work products that inform marine and coastal management and policy decisions. Advancing science-informed decision-making is the foundation of our work. Peer review is a key tool we employ – both internally and as a service for partners – to meet ocean resource management needs so that decisions can be based on credible, defensible scientific information. We have compiled these guidelines based on our experience conducting successful reviews on a diverse array of topics, and consideration of best practices in multiple contexts. We offer insight into developing a review process that will maximize the potential for constructive outcomes, uphold our core review principles, and consider the needs and practical interests of the requesting agency or organization. This handbook will serve as a living document, to be updated as we continue to learn.

About Ocean Science Trust

Ocean Science Trust is a boundary organization. We work across traditional boundaries, bringing together governments, scientists, and citizens to build trust and understanding in ocean and coastal science. As an independent non-profit organization, we empower participation in the decisions that are shaping the future of our oceans. We were established by the California Ocean Resources Stewardship Act (CORSAs) to support managers and policymakers with sound science.

For more information, visit our website at www.oceansciencetrust.org.

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1. Introduction

Scientific and technical peer review (hereafter, “peer review” or “review”) is widely applied across numerous technical disciplines to assure products are of high quality, reflect solid scholarship, and that the information contained is accurate and based on rigorous, sound scientific methods. Review is one of several science integration tools that we employ internally and externally, such as **Expert Judgment** and **Science Needs Assessment**, to advance a constructive role for science in decision-making on a broad range of marine and coastal issues.

Government entities or organizations in natural resource management and policy may call upon Ocean Science Trust to coordinate review of products that contain important scientific and technical determinations. If viewed by diverse audiences as legitimate, credible and transparent, an independent assessment can advance the use of rigorous scientific information in management and policy decisions.

Our review processes are designed to promote candor among reviewers and provide useful outputs that accommodate processes and goals for a variety of agencies and organizations. As we discuss in more detail throughout this document, review processes can vary widely depending on the nature of the review request, and may range from anonymous independent written reviews, to highly transparent in-person panel workshops.

Our ability to direct a review depends on the project deadline, available resources and staff commitments, and the role of the review in relation to our organizational goals. Requests within our purview include those that align with our mission to advance a constructive role for science in decision-making, and where we perceive that our involvement as a boundary organization will provide added value to the process or final product.

1.1 What is Scientific and Technical Review?

Science is often used to inform natural resource management and policy decisions. Peer review is the process by which experts evaluate the extent to which a work product presents credible, defensible scientific conclusions. Review processes and guidelines can vary depending on the practitioner, including academic journals – which are charged with assessing the scientific validity of manuscripts submitted for publication consideration – to organizations like the Environmental Protection Agency (EPA) and Office of Management and Budget (OMB) who employ a highly systematic process for planning, conducting and completing peer reviews (EPA, 2015; OMB, 2005).

Our external review processes draw from and build upon the traditional academic journal review and other existing models in order to accommodate the complex needs of clients based in government. Our reviews do not focus on the management and policy decisions or actions, but rather on the underlying scientific and technical elements presented within the work products that support decision-making. Expert reviewers consider factors such as the appropriateness of methods, soundness of reasoning, accuracy of calculations, and completeness of supporting information.

To provide useful recommendations, participating experts must understand the political and policy context of the issue at hand, as well as the role of the review in shaping the final product and its use in a decision-making process. Often, management and policy recommendations within a product are closely intertwined with scientific information. This is what sets our processes apart from peer review conducted for academic journals, and is the reason that agreeing on a scope of review at the outset, and clearly articulating the questions reviewers will address with their assessment, are vital parts of constructing a successful review.

Given the breadth of management and policy agencies with marine and coastal resources under their jurisdiction, we coordinate reviews for products in many forms and on a diverse range of topics, including fish and wildlife management, sediment management, underwater sonar impacts, aquatic invasive species, marine gas and oil exploration, and water quality, among others. Products suitable for review may include reports, proposals, methods, and approaches (see Box 1).

Each review process is based on the unique focus of the review, the nature of the topic, and the intended review output(s). We conduct timely and cost-effective review processes that address the diverse needs of state and other partners. No single review process is likely to work best in all situations. Below we draw on our experience over the last five years to discuss our approach and some of the key elements we consider when developing a review process.

Each review process is based on the unique focus of the review, the nature of the topic, and intended review output(s).

BOX 1. WORK PRODUCTS SUITEABLE FOR SCIENTIFIC AND TECHNICAL REVIEW:

- Scientific and technical reports, management plans, guidance documents, or studies
- Research or grant proposals and strategies
- Environmental impact reports and assessments (e.g., California Environmental Quality Act (CEQA) reports)
- Risk assessments, technical models, methods, and protocols
- Analytical methods, data, analyses, assessments or approaches

1.2 Ocean Science Trust's Core Review Principles

When building a scientific and technical review process, we seek to balance and adhere to six **core review principles**, defined below in the context of our work (Figure 1). Although we review many different kinds of products, these principles ground every review we undertake and shape the products that we develop. The relative importance of each will vary depending on the project materials and goals of the requesting partner.

SCIENTIFIC RIGOR	The process should evaluate the validity, accuracy and thoroughness of a work product to support scientifically grounded decision-making.
TRANSPARENCY	Given the goals of the review, we build into the process an appropriate level of openness to balance public accountability with reviewer anonymity.
LEGITIMACY	We work with clients to consider the role of review with respect to the larger goals and objectives of our organization, and those of the requesting partner.
CREDIBILITY	The review should be unbiased, draw on the best-available science and most relevant expertise, and produce review outcomes recognized as credible by diverse audiences.
SALIENCE	Each review process considers the most relevant scientific information while balancing management needs and timelines.
EFFICIENCY	Our process is cost-effective and utilizes time, resources, and effort in an efficient manner to create the best possible output.

Figure 1. Our core review principles ground every review we undertake and shape the products that we develop.

2. Scoping a Review

2.1. Why is Review Being Considered?

Often, agency mandates require all scientific and technical documents that inform or guide decision-making be submitted for review before finalization, adoption, or implementation. On the other hand, some clients may elect to undertake a review process to increase the credibility and scientific rigor of a document to meet their own internal goals, or increase a grant proposal's chances for funding. In all cases, understanding how an agency or organization accesses and uses science will inform the review scope, process, and outputs, and will assist experts with focusing their assessment and feedback.

We build mechanisms into our approach that encourage thoughtful consideration of the review results.

2.2. How Will Review Results be Meaningfully Used?

In approaching any review, we carefully consider the appropriateness of Ocean Science Trust's involvement, and reach a decision based on two factors. First, the work product to be reviewed must have a meaningful role to play in coastal and ocean resource management, regulation, or policy in California. Second, we seek to understand whether the review itself is likely to play a constructive role in improving the science that underpins the work product in question. In other words, how will the client use the results, and demonstrate meaningful consideration and response that improves the work product, and by extension better informs a decision at hand? In all cases, we strive to avoid conducting reviews that would serve only as a "rubber stamp" or a "check box" for a work product. A discussion of how feedback will be considered and taken up in any final project document(s) is therefore an important part of the initial review scoping phase, and also a key component of conversations with the requesting partner throughout the process. As coordinators of all aspects of the review process, it is also incumbent upon us to ensure reviewers have a clear understanding at the outset of how their participation will contribute to improving the science and how both the science and review results will be used.

While we cannot always guarantee that the client will utilize results from a review, or that a document will be changed based on the review, we build mechanisms into our approach that encourage thoughtful consideration of the review results. This can be done simply through regular communication with high-level decision-makers involved in the project, or by including mechanisms such as the mediator assessment (see section 3.1). Public accountability may also be an important mechanism for encouraging evaluation of the review results. Ocean Science Trust will make available a final summary of the review, as well as the scope and process, which can illuminate the goals of the review and the roles and responsibilities of each party, allowing interested stakeholders to track review responses and revisions themselves and discuss any concerns during a public process.

2.3. What Will be Reviewed?

Prior to identifying and engaging reviewers, we work closely with the requesting partner to develop and formalize a **review scope** (see Box 2). The review scope identifies the charge to reviewers and the scientific and technical issues on which the client would like feedback, and specifies the roles and responsibilities of each party. Developing the review scope often requires access to draft review materials. Often, it is not the entire project document that is reviewed, but rather specific sections where scientific information, analyses, or data are utilized. In such cases, the process and purpose for selecting the components under review should be clearly noted to communicate how the scope was determined (i.e., that review topics were not "cherry picked").

2.4. What Process Best Meets the Need?

When it comes to building a review process, there is no one-size-fits-all. The diversity of review requests we receive requires a suite of approaches that can be tailored to each case, and not all products will receive the same level of review (see Appendix A: Levels of Ocean Science Trust Scientific and Technical Review). Generally, the intensity of review should be commensurate with the significance of the information and its implications for management or policy, as well as the level of scientific uncertainty or controversy (OMB, 2005; NRC, 2004).

Based on our scoping exercise with the requesting client, we develop and present a proposed **review process** for eliciting scientific and technical feedback from multiple scientific experts. This outlines the appropriate review approach, identifies resources (budget, staff, reviewer availability, etc.), and proposes a timeline for completion of the review.

The review scope and process documents articulate shared expectations for the review at the outset and are made publicly available on our website. They should be referenced throughout the process to help ensure that reviewer assessments are within scope and keep all parties involved in agreement about the process and timeline. These documents are also useful resources for stakeholders that wish to better understand and follow the process.

BOX 2. COLLABORATIVELY SCOPING A REVIEW

During initial review planning meetings with the client, we often ask the following scoping questions before proposing an appropriate review process:

BACKGROUND - What is the history of the work product and what created the need for external review?

Understanding the history of the work product, the management context, and the legislative or policy mandates of an agency will help determine the most appropriate review process. This background information can also elucidate any political sensitivities or concerns of stakeholders that should be considered during process development.

Many agencies are required to submit management and policy documents for review prior to finalization. For example, the California Department of Fish and Wildlife (CDFW) must submit documents prepared by their staff for independent review in accordance with the Marine Life Management Act (MLMA) and the Fish and Game Code. When working with CDFW, understanding these requirements for external review under the MLMA will help us appropriately tailor the process to fulfill agency mandates. In other instances, agencies that are not typically required to undergo external review may choose to do so particularly for science that informs highly controversial decision-making processes (for example, permitting of oil and gas exploration) in order to demonstrate that the science has undergone a thorough independent evaluation.

REVIEW REQUEST - Can you articulate the review request as precisely as possible? Where can reviewers add value and be constructive? What questions will the reviewers address?

In the interest of getting the best feedback in an efficient manner, it is important to determine whether the client is looking for a line-by-line assessment of a document, an overall evaluation, or a more focused assessment of, for example, a methodological approach. Often, elements of a work product contain science that has already been reviewed. It is also likely that some elements of a project document cannot be easily modified or edited without significantly delaying the process (e.g., if a method has been agreed upon through an extensive public process, or modifications must be brought in front of a high-level council).

Our role is to take that request and develop a scope that is feasible given resource considerations, and focus the review on areas of the project documents that would most benefit from an independent assessment. Once the scope is mutually agreed upon, we draft detailed instructions for reviewers intended to guide their assessment of the project documents.

CONSIDERING STAKEHOLDERS - What would be an appropriate level of transparency? What is the role of stakeholders in the review process, if any? Is there a public process associated with the development of the project materials?

State agencies often have procedures or requirements for public engagement in shaping environmental regulations and policies. Often, project documents undergo a public review or involve stakeholders in the development process. Understanding these procedures will inform whether or not we include a public element in the review process. Sometimes an agency's public comment period may be a more appropriate venue for clients to engage stakeholder input. However, involving the public in a scientific review can also increase the credibility of, and buy-in to, the review outputs (see section 4.2 for more on considering stakeholder participation). Including stakeholders will often extend the timeline and require additional resources (e.g., meeting space, staff time) so we must carefully evaluate the tradeoffs. We must also consider the transparency of the review process and the decision about whether to make reviewer names and/or the final review report publicly available. Highly controversial issues often focus greater attention on transparency and buy-in to the final review outputs, but it is worth noting the need is still just as great for less contentious issues.

DELIVERABLES - What kind of final product, and in what format, would be most useful?

It is important to understand how the results of the review will be used and the pathways for science to be taken up by an agency or organization. Just as our processes for review are flexible given the request, so too is the form of the review outputs. Outputs can include one or more of the following:

- formal memoranda;
- summary reports that synthesize viewpoints of multiple reviewers;
- line-by-line comments and in-text edits to the draft materials; and
- collated responses to guiding questions.

Each serves a different purpose and depends on client needs.

TIMELINE - What is your timeline for completion of the review?

The scoping process should identify client milestones and deadlines. Timeline considerations include: scoping and process development, selection of reviewers and their availability to conduct a review, receipt of draft documents from the client, coordinating meetings among reviewer and client schedules, review of materials, fulfilling additional data or information requests of the client, revisions to the project document by authors, drafting of the final summary report, and any in-person or remote presentation of the review outcomes.

INCORPORATING FEEDBACK: How will the results of the review be considered?

Are the clients expected to respond in writing to reviewer feedback or provide a revised draft? Will the draft be released for public comment following the review? It is important for reviewers to understand where the review fits in to the larger project development process so they can provide useful feedback for the client. Our decision to undertake a review will consider whether an independent assessment has a role to play in improving the final work product.

3. Selecting a Review Type

Figure 2. Review Process Steps



A written review approach is suitable for obtaining general suggestions and may be appropriate for less complex or controversial products.

Choosing an appropriate and feasible review type will require considering the complexity of the review materials, timelines, as well as available resources. In any review process, it is our intent to provide a final evaluation of the work product that is balanced, fairly represents all reviewer assessments, and provides feedback that is constructive. We must consider the best approach for drawing out information from multiple experts that will best address the scope of review. Such processes can vary broadly in terms of their structure, formality, and outputs, but will always consider management needs and timelines. Figure 2 provides an overview of 8 basic steps for conducting a review.

Soliciting individual, anonymous written assessments can be a powerful way to engage reviewers if the product under review is a more narrowly focused report, proposal, or technical paper. In other cases, review requests contain multidisciplinary scientific and technical elements, complex modeling or analyses, or work products for which a rigorous review would require balancing across multiple scientific perspectives. Public panels are more transparent than closed discussions, but may affect the candor of reviews or the ability to secure experts willing to serve openly. On the other hand, soliciting individual comments is potentially faster and less costly. Strict time constraints and budgetary restrictions may impose limitations on what can be reasonably achieved and may make a less elaborate review mechanism imperative.

In this section, we describe **two scenarios** that represent the range of approaches available that can be adapted to meet diverse review needs. Whether the project document would benefit from a line-by-line assessment of the underlying science, or higher-level recommendations, the two approaches described here provide a framework that can be adapted to meet diverse review needs. After we have worked with the client to determine which review approach is most appropriate given the request, we build out the process by thinking through additional components, discussed further in section 4.

3.1. Scenario I: Written Review

In a **written review** approach, we call upon multiple scientific experts to provide independent written assessments of a work product. A written review approach would be suitable for obtaining general suggestions and recommendations for improving the work product as a whole, including feedback on structural elements. This approach solicits multiple independent assessments, often without reviewers ever interacting with one another. It may be appropriate for less complex or controversial products, or when dealing with strict timelines for which in-person meetings or more complex process elements are infeasible.

Developing Guidance for Reviewers

Ocean Science Trust works in collaboration with the requesting partner to develop review instructions, including guiding questions for reviewers that focus their efforts on the appropriate scientific and technical aspects of the work product (see Box 3). Spending time developing appropriate guidance is a valuable exercise and can provide an outline for drafting the final review report.

We provide reviewers with:

- the project document(s) and any supporting materials, data and analyses
- review instructions
- review scope and process documents

During a written review, reviewers prepare individual responses based on guiding questions in the review instructions. Reviewers are asked to support their comments, positive or negative, with specific evidence and suggestions for improvement, and identify within the project documents where additional relevant sources of information could be integrated. Reviewers may also be asked to comment on the clarity and presentation of the project documents, including the degree to which the style and organization of the documents are cohesive and clear. In addition to their direct responses to specific questions, reviewers are often asked to provide specific in-text comments directly on the project document(s) in the form of “track-changes.”

Incorporating Reviewer Feedback

Ocean Science Trust organizes reviewer assessments and delivers them to the requesting partner or author(s). Authors will be

BOX 3. POTENTIAL GUIDING QUESTIONS TO REVIEWERS

- **METHODS AND APPROACH** – Were the methods used in this project appropriate to address the hypothesis, goals, and objectives of the project? Was the experimental design scientifically sound?
- **OBJECTIVES ASSESSMENT** – Did the authors accomplish the objectives of their project? In what areas were they successful? What areas still need development? Are there ways in which the project report could be improved or enhanced to more effectively meet the project objectives or resource management information needs?
- **SCIENTIFIC AND PROFESSIONAL MERIT** – Did the project contribute to a discipline, and/or advance the state of the science in this field? Did the authors use novel methods, or provide new approaches to apply toward California ocean and coastal issues?
- **ADDITIONAL COMMENTS** - Are there any additional comments you would like to provide that were not covered in the above questions?

asked to incorporate review feedback into the work product as appropriate. In processes where a revised draft is requested, authors are asked to provide written responses identifying how comments were addressed. When comments cannot be feasibly addressed, the requesting partner will be asked to state why such comments are not to be incorporated. A revised project document or work product must then be submitted to Ocean Science Trust.

In some cases, as agreed to in the review scope, the revised document will be sent to the reviewers again, or to an expert mediator. In cases where the intent of the review is not to specifically improve the document under review, but rather to determine how or whether the document could be used in decision-making, Ocean Science Trust may conclude the review by developing a final review summary and submit this, along with individual reviews, to the client.

Expert Mediator Assessment

If we determine that the review would benefit from a **mediator assessment** (see Box 4), Ocean Science Trust identifies a selected expert among the reviewers, or identifies an additional expert, to evaluate whether the authors adequately addressed comments from reviewers. A mediator can determine where further response and revision is warranted.

Once the authors submit written responses to reviewers' comments and a revised product, Ocean Science Trust prepares instructions for the mediator to ensure he or she takes into consideration the specifics of each written review, the feasibility of the requested changes, and how the authors' responses to the reviews have impacted the scientific and technical elements of the work product. Guiding questions may include:

1. Do changes made by the authors adequately address reviewer comments?
2. In cases where authors did not change the text based on a reviewer comment, is the author's explanation satisfactory?
3. Are there any additional comments or concerns you would like to provide Ocean Science Trust that are not covered by the previous two questions?

We provide the instructions to the expert mediator along with the original reviewer comments, the original and revised project drafts, and the authors' written responses to reviewers.

Developing a Final Review Summary

Ocean Science Trust produces a final summary for the client and additional audiences as appropriate. The length and format of the summary, along with a determination of what final materials will also be made publicly available (such as individual written reviews), will vary across review processes depending on the review materials, but should be agreed upon with the client at the outset.

A mediator assessment evaluates whether the authors adequately addressed comments from reviewers.

BOX 4. WHEN IS A MEDIATOR ASSESSMENT BENEFICIAL?

A **mediator assessment** provides an expert determination of whether reviewer comments were adequately addressed. It can be a valuable component to enhance credibility of the process by holding the requesting partner accountable for satisfactorily incorporating reviewer feedback into the work product. It also takes the job of arbitration out of Ocean Science Trust's hands, which can be one more layer of independence in cases where the client has close ties to our organization. The expert mediator phase may extend the review process several weeks, but is often recommended when the scientific information or outputs from the product will be directly influencing controversial or costly management or policy decisions.

3.2. Scenario II: Technical Workshop Review

In a **technical workshop review**, we convene a panel or committee of experts to collaboratively participate in a review via remote webinars and/or in-person workshops. Workshop reviews allow interaction between reviewers with different expertise and perspectives, and where appropriate, with the client and staff scientists most familiar with the work product. Such a method is often appropriate when a work product is highly complex (length, content, method, interdisciplinarity, etc.), influencing controversial or costly management decision, novel, or the goal of the review is to provide higher-level guidance and feedback as opposed to a line-by-line assessment. For example, a review of a complex fishery assessment model would likely benefit from group discussion because it allows the client an opportunity to walk reviewers through the technical model, including use and functionality, and answer questions about the materials before reviewers convene independently to conduct their assessment.

Group discussions via in-person workshops and/or remote webinars can be very helpful as they allow interaction among reviewers with different perspectives and expertise. Reviewers can discuss relevant materials, ask questions, and integrate the expertise and viewpoints of all parties before making recommendations. Clients can also learn a great deal from interactions with reviewers via in-person workshops that extend beyond the receipt of written reviews. A dynamic interaction between reviewers and the requesting partner may allow for more collaborative feedback, and the potential for consensus in reviewer evaluation. Finally, in-person workshops can facilitate our role in balancing multiple viewpoints and providing a more cohesive narrative that balances both positive and negative critiques.

Developing Guidance for Reviewers

As with our written review approach, once reviewer participation is confirmed, often including identifying a review committee chair (see section 4.1 *Assembling a Review Team* for more information on reviewer selection), we compile all appropriate materials and distribute them to reviewers along with review instructions.

Conducting a Workshop or Remote Meeting

In advance of any meetings, it is important to provide participants with an agenda that outlines the goals of the meeting, identifies supplementary materials, and maps out exactly how time will be spent. Experts are asked to familiarize themselves with the materials under review, and in some cases, conduct advance work to bring to the group (e.g., run analyses, prepare presentations, or provide written responses to questions).

Some additional workshop considerations include:

- Who should attend the workshop and are they available to participate? Is the client involved, or is this an opportunity for reviewers to convene independently (or both)?
- Is the workshop, or components of it, open to the public?
- What questions will reviewers address? What types of presentations would be useful?
- How many meetings are needed to complete the review? If an in-person workshop is necessary, how long should it be (single- or multi-day)?
- What are the costs associated with reviewer travel and in-person meeting hosting?

Technical workshop reviews are often appropriate when a work product is highly complex, influential, or novel.

If group interaction is still deemed beneficial, but infeasible, remote webinar(s) may be an effective alternative. Often breaking the review up into smaller components and hosting a series of short webinars (1-2 hours) that focus on a subset of the review scope can ensure there is enough time for in depth discussion of each item.

The review committee chair can be a valuable resource in helping to plan an effective review workshop or meeting. He or she may facilitate conversation, keep participants on track, and help advance the agenda. In other cases, facilitation responsibilities may fall to Ocean Science Trust staff.

Developing a Final Review Summary

Reviewers contribute to developing a final summary report that provides recommendations focused on improving the scientific and technical aspects of the review product. We use written responses to guiding questions from the review instructions, as well as input from discussions during remote meetings or in-person workshops, to draw comments emerging from across the review committee, and prepare the final summary report. Ocean Science Trust works with the panel chair to assemble a final report that appropriately represents the views of each panelist. Often, this includes first developing a draft report outline with the review committee. Ocean Science Trust then works with reviewers to contribute content, and finalize the full report.

In cases where the review results are highly technical and would benefit from more detailed explanation, or in cases where substantial revisions are necessary, Ocean Science Trust may choose to convene a results “preview” with the client where the panel chair and/or Ocean Science Trust presents the draft results to the client, who then has an opportunity to respond to and ask questions of reviewers. Reviewers may consider input from the client as they finalize the summary report. A briefing can help clients prepare for the coming results, and plan their next steps to address the review findings.

4. Key Process Steps

Whether a written review or a technical workshop process, there are a number of key process components that must be considered in the course of designing a review.

4.1. Assembling a Review Team

We work with the client to determine an appropriate number of qualified reviewers and the range of expertise needed given the nature of the work product and available resources. Typically, reviewers are selected after we have received and assessed the draft work product. A review team typically ranges from three to six individuals. Additional reviewers may be necessary for projects that are particularly complex or controversial. Upon agreeing to our review terms, reviewers are asked to sign a review contract and are provided with the project scope and process documents.

Soliciting Reviewer Recommendations

We often begin a reviewer selection process by soliciting recommendations for experts from the Ocean Protection Council Science Advisory Team (OPC-SAT). We also compile a list of potential reviewers from our own network of scientific and technical colleagues. Depending on the needs of the review, we may choose to solicit recommendations from additional audiences (e.g., the client), or on rare occasions, conduct a public nomination process with relevant stakeholders.

Reviewer Selection Criteria

We seek to assemble a review team with membership from multiple affiliations and disciplines, often including industry, academia, environmental, and management communities to deliver balanced feedback and multiple perspectives to address the issues presented in the review scope. Each reviewer should have demonstrated knowledge, experience, and skills in an area relevant to the review product(s). Reviewers may come from academic institutions, independent or non-governmental entities, and state or federal agencies. Ocean Science Trust may choose to develop a set of minimum qualifications for solicited reviewers to ensure that all nominators understand the background knowledge and experience required to serve on a review panel. While input from the client may be considered in the selection process, we maintain the independence of the review process and outcomes.

We seek to assemble a review team with membership from multiple affiliations and disciplines.

Conflict of Interest

In the service of providing feedback intended to encourage the best possible product, and in accordance with best practices for scientific and technical review, all reviewers will be required to sign a form asking individuals to declare whether they perceive a conflict of interest (see Box 5). Reviewers should be independent from the generation of the product, free from institutional or ideological bias regarding the issues under review, and able to provide an objective, rigorous, and thoughtful review. Reviewers should offer their opinions based solely on their best understanding of the relevant science, unencumbered by personal or financial considerations, or relationships that might impair their ability to provide unbiased advice.

Ocean Science Trust will evaluate declared conflicts on a case-by-case basis. Conflicts of interest do not automatically disqualify an individual from participating. We may instead choose to alter the individual's role in the process. For example, on a panel reviewing grant proposals, we may ask a reviewer to recuse him or herself from certain discussions that involve a particular proposal for which they know or work closely with the authors, while still participating in reviewing the remaining proposals.

BOX 5. CIRCUMSTANCES PRESENTING A CONFLICT OF INTEREST

1. Financial interest in the outcome of the proposal or review by any of the parties below:

- The reviewer, the reviewer's spouse, minor child, or business partner.
- The organization where the reviewer is employed, or where the reviewer has an arrangement for future employment or is negotiating for employment; or
- The organization where the reviewer is an officer, director, trustee, or partner.

2. An affiliation with the investigator's institution(s) or state agency:

- Current employment at the institution or state agency as a senior or lead researcher, manager, or similar position. Other current employment with the institution or state agency (e.g., consulting or an advisory arrangement, or you are being considered for employment with the institution).
- Formal or informal re-employment arrangement with the institution or state agency.
- Any office, governing board membership or relevant committee chairperson in the institution or state agency. (Ordinary membership in a professional society or association is not considered an office.)

3. A relationship with an investigator, project manager, or other person who has a personal interest in the review:

- Known family or marriage relationship. (Conflict only if the relationship is with a principal investigator or project manager.)
- Business or professional partnership.
- Employment at the same institution within the last 12 months.
- Past or present association as thesis advisor or thesis student.
- A collaboration on a project or on a book, article, report or paper within the last 48 months.

Compensating Reviewers

Ocean Science Trust will offer a reasonable honorarium to reviewers and expert mediators to compensate them for their time in participating in the review. Honoraria amounts can range from \$100 to \$1000, depending upon the time commitment. Often, state or federal employees that serve as reviewers cannot accept honoraria. Many scientists view review as their responsibility as members of the academic community and may also forego honoraria. For reviews involving in-person attendance at a workshop, reviewers are reimbursed for any expenses related to travel.

4.2. Balancing Elements of Transparency

Promoting transparency in the review process is far from straightforward. Openness about a review process – especially one focused on publicly funded products or programs – is important. If concerned citizens distrust the review process, they may also distrust the review output. But total transparency can also jeopardize the robustness and candor of the review. A strong review process should also promote the free exchange of ideas. Thus, reviewers must be provided some space to offer comments without fear of being misinterpreted or taken out of context. This is especially important in the early- to mid-stages of the review process, when reviewers are still working to fully comprehend the work product and associated background, and debating their interpretations with colleagues. The potentially competing values of transparency and confidentiality can be balanced in a number of ways (see Box 6). For example, hosting of public review meetings could be balanced by convening independent conference calls among just the review committee to allow time for candid dialogue.

The potentially competing values of transparency and confidentiality can be balanced in a number of ways.

Reviewer Anonymity

Ocean Science Trust will work with the client during the scoping phase to balance confidentiality and transparency, and recommend the most appropriate option for reviewer anonymity. Potential options include maintaining the anonymity of reviewers throughout the review (to both the public and the client), making reviewer identities publicly available at the outset, or releasing reviewer names upon completion of a review.

Preserving reviewer anonymity (i.e., a single-blind review where reviewer identities are kept anonymous, as is the case for most academic peer review) can promote candor in the review process, and foster rigorous critique of the work product. Requiring reviewers to serve openly may reduce the pool of willing experts – particularly on politically sensitive or controversial topics – or potentially compromise the quality, rigor, or tone of the reviews. Given that our reviews focus on scientific and technical elements (and not on management, regulation, or policy), maintaining reviewer anonymity can also ensure the review is conducted in a timely and efficient manner.

On the other hand, open review (allowing reviewer names and affiliations to be associated with the review) may increase credibility of, and stakeholder buy-in to, the review process and its outputs (i.e., stakeholders might be more accepting of a review outcome if they trust and respect the reviewers involved). This is particularly important for science that informs highly contested management or policy decisions, or decisions on an important public resource.

Confidentiality of Review Materials

We balance our **core review principles** (Figure 1) when determining which materials are made public – including draft project documents under review, review instructions, meeting agendas and/or summaries, presentations, etc. Review results, in an appropriate form, will be released publicly upon completion of every review process. This could take the form of collated individual reviewer assessments, or a consolidated final summary report or memo. The level of confidentiality for a review will fall somewhere on a spectrum between entirely open (i.e., all review materials are made available), to entirely confidential (i.e., only the scope, process and a synthesized final summary are released).

Stakeholder Participation

For politicized, highly sensitive, or controversial topics, credibility and transparency of the review process and outputs may be of particular importance in meeting the goals of the review. First understanding who the key stakeholders are, and how they are likely to react to the review outcomes is important in know if and how to best engage them in the process to encourage buy-in. Participating in the process does not mean that these groups or individuals will be directly involved in conducting the review or assessment, but their role in the larger process may be considered. Stakeholder engagement may include sharing review materials online, sending email status updates, implementing a public reviewer nomination process, or holding public webinars, meetings and/or briefings where time is allocated for public comment. It is also important to manage stakeholder expectations and provide clear guidance on how they can participate as well as how their input will be utilized.

BOX 6. TRANSPARENCY IN A REVIEW PROCESS

Successful science integration requires not only bringing the best scientific thinking on an issue, but also organizing diverse communities around the science to build trust and buy-in to the review process and its outputs. This was particularly apparent in the Ocean Science Trust review of the California Department of Fish and Wildlife (CDFW) survey design and methods used to estimate densities of red abalone (*Haliotis rufescens*) in northern California. Density surveys inform red abalone management and regulations set by the Fish and Game Commission. Given the large stakeholder interest in the abalone fishery and its management (recent declines in density had prompted several bag limit reductions, site, and fishery closures), public buy-in to the review outcomes and acceptance of the decisions based on the work product was of particular interest to CDFW. To meet this goal, Ocean Science Trust developed guidelines for stakeholder involvement throughout the review process. This included having reviewers serve openly, and soliciting recommendations for reviewers from abalone diver groups to ensure their viewpoints were represented on the review committee. In addition, Ocean Science Trust hosted public webinars that allocated time for public comment, and all review materials were made available on Ocean Science Trust's website. A regular public newsletter notified stakeholders of recent advancements in the review process and of upcoming public webinars. The success of the review was recognized by stakeholders and management alike, and was in a large part due to the elements of transparency considered as part of the review process.

4. Promoting Efficiency: Timeline and Budget

Scientific reviews of agency work products are often publicly funded, and it is important for us to implement a cost-effective process. Effective planning at the outset can help anticipate potential hurdles; however, it is equally important to build in flexibility in the process to allow for reallocating staff time and resources as the review unfolds.

In our **review process** document, we include a proposed review timeline and budget that considers management needs and time constraints, as well as key process steps (Table 1). Total timeline and cost for reviews will vary depending on multiple factors, including:

- the size and complexity of the review materials;
- the goals of the review;
- the availability of appropriate experts;
- management timelines for delivery of the final work product; and
- the selected review process.

Review processes for management and policy decision-making products are often more complicated than a traditional academic journal review. Thus, adequate time must be built into the product development process at the outset. It is recommended that notification of a review request come several months prior to delivering the draft documents to allow for internal resource and logistical planning. Time should be budgeted for reviewers to familiarize themselves with the review materials, as well as for drafting, reviewing and finalizing the summary report. Additional data, analyses, or document requests from the client, as well as including a public component to the review will also add time to the process.

The cost for conducting a scientific and technical review will vary depending on the number of experts required, the complexity of the review, and whether reviewers are required to meet in person. Appendix A provides a range of review options, with approximate costs, as well as case study examples of each.

Table 1. Range of cost options for individual process elements.

Process Consideration	Process Component	Cost
Review Method	Written review	\$
	Panel review with remote webinar(s)	\$\$
	Panel review with in-person workshop(s)	\$\$\$
Product Type Under Review	Technical report, plan, strategy, EIR, proposal, etc.	\$
	Technical model, research method or protocol evaluation and testing, etc.	\$\$-\$\$\$
Product Length or Complexity	<100 pages, moderate complexity	\$
	100-500 pages, moderate complexity	\$\$
	>500 pages and/or highly complex	\$\$\$
Number of Reviewers	3	\$
	4-5	\$\$
	6 or more	\$\$\$
Final Output	Brief summary report	\$
	Public summary, in-depth review collation and mediator assessment summary	\$\$
	Multiple reports or outputs	\$\$\$
Stakeholder Participation	Limited stakeholder participation	\$
	Considerable stakeholder participation	\$\$-\$\$\$
Expert Mediator Assessment	No	\$
	Yes	\$\$-\$\$\$
Reviewer Compensation	Honorarium ~\$100 - \$250 per reviewer; several hours of participation; documents less than 100 pages	\$
	Honorarium ~\$500 per reviewer; 8+ hours of participation; documents >100 pages in length; required attendance at remote meetings or in-person workshops.	\$\$
	Honorarium ~\$1000 per reviewer; several working days of participation; expert mediator.	\$\$\$
Workshop Component	None	\$
	Series of webinars	\$\$
	Single or multi-day in-person workshop(s)	\$\$\$
Presentation of Final Results	None	\$
	Final results preview briefing	\$\$
	Travel to and presentation at a public meeting or hearing	\$\$\$

5. Conclusion

Scientific and technical review requirements are built into many state mandates and legislation, and are vital to supporting the State's natural resource management decisions with rigorous, credible science. While scientific and technical review can be a resource- and time-intensive process, it can help to demonstrate that resource management and policy project documents are scientifically valid and defensible. In addition to enhancing a work product, the outputs from a review can also demonstrate an agency or organization's commitment to objectivity, help build relationships with stakeholders, and establish stronger collaborations with the academic community.

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Appendix A. Levels of Ocean Science Trust Scientific and Technical Review

Tier 1: Written Review

Approximate Budget: \$15-20,000

With a “Tier 1” review process, Ocean Science Trust will coordinate an assessment of a short (<100 pages, moderately complex) project document with approximately three anonymous expert reviewers. Reviewers will be asked to prepare individual, independent written responses and provide in-text edits on the project document(s). Reviewers will not be required to meet in person, or interact with one another or the client. A small honorarium will be offered. Ocean Science Trust will conclude the review by providing the client with collated individual reviews and in-text edits, along with a brief report that includes an overview of the review process and summary of reviewer assessments.

This process is appropriate for documents where the intent of the review is to validate the scientific accuracy and appropriateness of the document content and/or to determine how or whether the document could be used in decision-making. This may also be appropriate for reviews with strict management timelines or budgets. Minimal additional process components are included.



Example “Tier 1” Review: Scientific and technical review of the information and conclusions presented in the “South Ellwood Natural Oil and Gas Seeps Technical Memorandum”

Client: California State Lands Commission

More Information: Project webpage; scope and process documents; final public memo

The California State Lands Commission (CSLC) staff asked California Ocean Science Trust to coordinate an independent scientific review of *Relationship Between Oil and Gas Production and Natural Seep Intensity in the South Ellwood Field – Santa Barbara* (“Technical Report”), which summarized existing literature and scientific information linking sub-seafloor oil production with natural oil seep activity. The Technical Report was to be part of an Environmental Impact Report (EIR) to inform CSLC decision-making about whether to amend a state oil and gas lease to allow the requesting company Venoco to implement the South Ellwood Field Project.

Review Process and Outputs

The report under review did not include novel analyses or scientific information. As such, we developed a written review process that solicited independent feedback from three scientific experts on the scientific comprehensiveness and validity of the report’s content. Ocean Science Trust developed two review outputs: (1) a public memo that summarized the scope, process and resulting review assessments, and (2) collated reviewer assessments, including in-text edits and comments on the draft, as well as compiled responses to guiding questions. Because the output of the review was going to be considered as part of a larger EIR decision-making process, we did not include a “mediator assessment” component or require the client to submit a revised draft.

Transparency

To ensure willing participants and candid feedback given the controversial nature of the topic, we allowed reviewers to serve anonymously. The scope and process documents, as well as the summary memo were made publicly available.

Timeline

The review process, from initial scoping to delivery of the final report, took place over a 5-month period.

Honorarium

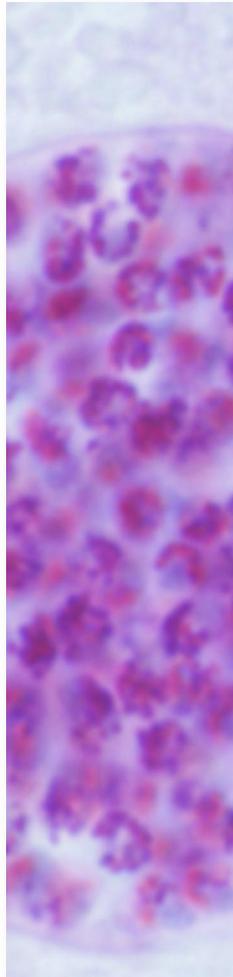
A \$150 honorarium was provided to compensate reviewers for their participation.

Tier 2: Written Review with Mediator Assessment

Approximate Budget: \$20-25,000

A “Tier 2” review process is most similar to traditional academic journal reviews. Ocean Science Trust will coordinate an assessment of a short (<100 pages) or long (100-500 pages or more) project document of moderate complexity, with inclusion of some of our additional process components (e.g., expert mediator assessment). We will identify approximately three to five anonymous expert reviewers, as well as an expert mediator. Reviewers will be asked to prepare individual, independent written responses and provide in-text edits on the project document(s). Reviewers will not be required to meet in person, or interact with one another. A small honorarium will be offered. Ocean Science Trust will provide reviewer assessments to the author and/or client and ask that they address reviewer comments and produce a revised document. We will select a reviewer, or additional expert to serve as an expert mediator to provide a written evaluation of whether the authors adequately addressed the comments from reviewers. Ocean Science Trust will conclude the review by producing a summary report for the client that includes: (1) an overview of the review process, (2) summary of the anonymous reviewer assessments, (3) a summary of author responses to reviewer comments and ways the report was revised based on the review; and, (4) a summary of the expert mediator’s written assessment.

Because this process holds the authors and/or client accountable for incorporating reviewer feedback, a “Tier 2” review is most appropriate for instances where the requesting partner aims to directly improve the scientific and technical elements of a moderately complex work product.



EXAMPLE TIER 2 REVIEW: Ocean Protection Council Project Final Report “Improved Detection of *Toxoplasma gondii* Oocysts”

Client: California Ocean Protection Council

The Ocean Protection Council (OPC) asked Ocean Science Trust to coordinate an external review of the scientific and technical determinations presented in the OPC-funded report “Improved Detection of *Toxoplasma gondii* Oocysts” conducted by members of the UC Davis Department of Pathology, Microbiology and Immunology, School of Veterinary Medicine. The report entitled summarized a laboratory method to concentrate and detect oocysts of the water borne parasite *Toxoplasma gondii* (*T. gondii*), a fecal parasite that causes the disease toxoplasmosis, which can lead to birth defects and neurologic disease in humans and fatal brain disease in federally threatened southern sea otters. The goal of the review was to ensure an efficient use of public funds towards improved ocean and coastal management, and ensure OPC-funded projects are supported by the highest quality science.

Review Process and Outputs

The report under review was a standard summary of a methods development process. As such, we solicited three independent experts (two of which reviewed the original project proposal) to conduct a written review process that included providing written responses to questions and in-text comments and edits to the project document. To ensure a high quality final product, we requested that the authors respond to reviewer feedback and submit a revised draft. A mediator was asked to determine the level to which comments were feasibly addressed.

Ocean Science Trust developed two review outputs: (1) a memo to the OPC that summarized the scope, process, resulting review assessments, and the mediator assessment, and (2) collated reviewer assessments, including in-text edits and comments on the draft, as well as compiled responses to guiding questions for the authors.

Transparency

Reviewers served anonymously.

Timeline

The review process, from initial scoping to delivery of the final report, took place over a 5-month period.

Honorarium

A \$100 honorarium was provided to compensate reviewers and the mediator for their participation.

Tier 3: Panel Review with Webinars

Approximate Budget: \$25-35,000

In a “Tier 3” review, Ocean Science Trust will convene a review panel or scientific advisory committee composed of three to six independent experts to participate in approximately four remote webinars. Reviewers will conduct the review on a moderately to highly complex report, technical model, or scientific approach/method. This approach includes several of our additional process components (e.g., interaction between reviewers and the client, consideration of stakeholder participation, webinars, and a final results briefing for the client, etc.). A moderate honorarium will be offered.

In this process, the client will have an opportunity to present to, or walk reviewers through the project materials, and be available to reviewers to answer questions about the materials before they conduct their assessment independent of the client. During webinars, reviewers will have in-depth discussions about the materials before coming to their final conclusions. The public may be invited to attend several of the review webinars and provide public comment, as appropriate. Webinar summaries may be made publicly available following each meeting. Ocean Science Trust will work with reviewers to prepare a summary of their assessment that considers input during each of the webinars, as well as any written feedback. One or more of the reviewers will be asked to participate in a results briefing for the client prior to release of the final summary report.

Such a method is often appropriate when a work product is highly complex (length, content, method, etc.), will influence costly management decisions, novel and/or controversial, or the goal of the review is to provide higher-level guidance and feedback as opposed to a line-by-line assessment.



CASE STUDY: Scientific and technical review of the reference point thresholds prescribed in the Fishery Management Plan for California spiny lobster (*Panulirus interruptus*)

Client: California Department of Fish and Wildlife

More Information: Project webpage; scope and process documents; final review report (Ocean Science Trust, 2015)

The California Department of Fish and Wildlife asked Ocean Science Trust to coordinate an external scientific and technical review of the reference point thresholds prescribed in the draft Spiny Lobster Fishery Management Plan (FMP) and supporting materials. CDFW’s purpose in asking for this review is to ensure the scientific and technical elements presented within the FMP provide a rigorous underpinning for management decisions and regulatory action. We worked with CDFW to develop a scope of review of key scientific and technical components of the FMP and its supporting materials where an. Thus, this was not a comprehensive review of the FMP, or the proposed approach to management contained therein. Rather, the central question of this review was: Given CDFW’s available data streams and analysis techniques, are the technical components, models, and supporting documents that underpin the FMP scientifically sound and reasonable?

Review Process and Outputs

The materials under review included sections in the FMP as well as a separate technical model that informed harvest control rules within the FMP. Given the technical nature of the model and the need to conduct accessory analyses, we determined that convening a four-member review committee and hosting a series of review webinars would be most appropriate. This allowed CDFW to engage directly with reviewers and present on the model methods, inputs and usability, and allow two-way interaction. Each webinar was focused on a separate element under review, and offered opportunities for the client to participate, as well as for reviewers to convene independently.

Ocean Science Trust worked with the review committee to develop high-level recommendations focused on elements within the scope, rather than a line-by-line assessment of the full FMP. Ocean Science Trust presented the results of the review on behalf of the review committee at the June 10, 2015 Fish and Game Commission Meeting prior to adoption of the FMP.

Transparency

Reviewers served anonymously until the review was completed to encourage candid feedback. Because of the extensive public process surrounding the development of the FMP, we did not build in stakeholder participation in the scientific review. The scope and process documents, as well as the final summary report were made publicly available.

Timeline

The review process, from initial scoping to delivery of the final report, took place over a 9-month period. Several events postponed the process, including unforeseen delays in the FMP development process and staff transitions.

Honorarium

A \$500 honorarium was provided to compensate reviewers for their participation.

Tier 4: Panel Review with In-Person Workshop

Approximate Budget: \$35-60,000+

A “Tier 4” review approach is similar to that of a “Tier 3” review, though experts will be required to participate in a single- or multi-day in-person workshop. The product under review is highly complex and will require considerations of many of our additional process components (e.g., interaction between reviewers and the client during in-person meetings, consideration of stakeholder participation, webinars, and a final results briefing for the client, etc.). A moderate to substantial honorarium will be offered. This approach must also budget for workshop hosting (food, travel, lodging costs for participant, etc.).

As in “Tier 3,” a “Tier 4” review is often appropriate when a work product is highly complex (length, content, method, etc.), influential, novel and/or controversial, or the goal of the review is to provide higher-level guidance and feedback as opposed to a line-by-line assessment.



CASE STUDY: Scientific and technical review of the survey design and methods used by the California Department of Fish and Wildlife to estimate red abalone (*Haliotis rufescens*) density

Client: California Department of Fish and Wildlife

More Information: Project webpage; scope and process documents; final report - full report and executive summary

CDFW requested that Ocean Science Trust coordinate a scientific and technical review of the survey design and the methods currently used to estimate red abalone (*Haliotis rufescens*) density in northern California, a method that informs management of the northern California recreational fishery in accordance with the Abalone Recovery and Management Plan. Specifically, CDFW sought review of their survey design and application, analysis and interpretation of existing data, uncertainty associated with existing methods, and its adequacy for informing catch limits and other management controls. The impetus for this review was driven in large part by a group of engaged stakeholders who expressed concerns about the accuracy of current density survey methods, given recent take reductions and fishery closures. Thus, we developed a robust review process that focused on transparency, and that considered stakeholder engagement throughout the process (see Box 6).

Review Process and Outputs

Ocean Science Trust convened a six member Scientific Advisory Committee (SAC), in alignment with the Procedural Guidelines for CDFW Ad Hoc Independent Scientific Advisory Committees (CDFW, 2012). The review process included multiple meetings:

- a remote kickoff webinar open to the public where CDFW presented to the reviewers;
- a one-day technical workshop involving CDFW and reviewers;
- multiple remote calls among the review team; and
- a results briefing webinar for CDFW and the public.

Because the audience for the report included decision-makers, CDFW project managers and the public, we worked with the SAC to produce a high-level executive summary as well as a more detailed full report that could guide future management that provided a lay audience-friendly explanation of the current methods and the recommended future approaches to track abalone populations.

Transparency

In addition to our standard reviewer solicitation process, we also sought nominations for experts that met minimum qualifications from key stakeholders. Experts served openly, and allowed their names to be associated with this process and review outcomes. All meeting materials (e.g., agendas and meeting summaries) and reports associated with the review process were made publicly available, and a regular newsletter was disseminated to allow interested parties to keep up with the process.

Timeline

The review process, from initial scoping to delivery of the final report, took place over a 12-month period.

Honorarium

A \$500 honorarium was provided to compensate reviewers for their participation.



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