610.145 Technical Note on "How to Write a Better Biological Assessment"

How To Write a Better Biological Assessment

Courtesy of USFWS/NOAA Fisheries Advance Interagency Consultation Training " Study Guide for Arguing Well".

Summary of this Study Guide

1. Consultations and the conclusions they are designed to produce should satisfy the characteristics of good arguments: their premises should be relevant, their premises should be acceptable, their premises should provide sufficient reason to accept their conclusions, and they should rebut any strong counter-arguments or challenges to their conclusions.
2. Service biologists should reconstruct arguments they make and arguments they receive using standard form, which clearly separate an argument's premises and conclusions from background information and other prose.
3. Once an argument has been reconstructed in standard form, arguments should be evaluated critically to determine whether they are acceptable as given, need to be made stronger, or need to be rejected
4. Causal arguments have a slightly different structure, but must satisfy the same criteria

1.0 Introduction

Section 7 of the Endangered Species Act of 1973, as amended, requires federal agencies, in consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service (the Services), to insure that their actions are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat designated for those species[1]. Although the principles, practices and protocols applicable to section 7 consultations are identified in section 7 of the ESA, its implementing regulations, and the Interagency Consultation Handbook, section 7 consultations and consultations products are reviewed according to the arbitrary and capricious criteria of the Administrative Procedure Act[2] (hereafter APA). Under the APA, the conclusions of consultations would be arbitrary and capricious if:

1. we relied on factors which Congress did not intend us to consider,
2. we failed to consider an important aspect of a problem,
3. we offered an explanation for our conclusion that runs counter to the evidence before us,
4. we failed to articulate a rational connection between the facts that were found and the conclusions we reached in our biological opinion

[1] 16 U.S.C. 1539(a)(2)

[2] 5 U.S.C. 706

Under the authority of the APA, courts can hold unlawful and set aside any findings or conclusion that are found to be arbitrary and capricious. Given this standard, legally-defensible consultation should produce conclusions that are not arbitrary or capricious.

Every biological opinion or concurrence letter the Services issue consists of a conclusion: "not likely to adversely affect," "likely to adversely affect," "not likely to jeopardize," and "likely to jeopardize," etc. The Services' challenge is to make certain that these conclusions are not arbitrary or capricious. We meet this challenge by insuring that our conclusion in biological opinions, concurrence letters, and our other written documents represent a reasoned reflection of all of the evidence available. In any consultation, the reasons and evidence supporting our conclusions must include the best scientific and commercial data available, the status of listed resources, the environmental baseline for an action area, the effects of a proposed action, and cumulative effects. So, to avoid being arbitrary and capricious, any biological opinion or concurrence letter must consist of a conclusion supported by the reasons and evidence that led us to that conclusion.

This is the definition of "argument": a series of statements that provide reasons and evidence for other statements, which represent conclusions (in the language of argument, statements that provide reasons and evidence are called "premises").

We can distinguish between "good" arguments and "bad" arguments, "strong" arguments and "weak" arguments. "Good" arguments provide premises that are sufficient to support the acceptance of the argument's conclusion. "Bad" arguments do not. In addition to providing premises that are sufficient to support their conclusions, "strong" arguments also defend their conclusions against counter-arguments or challenges using other evidence.

There are numerous methods for determining whether an argument is a good one, some require an application of the rules of formal logic while others apply rules of informal logic. Regardless of the system of logic being applied, good arguments meet the following criteria:

1. their premises are relevant to the truth of the conclusion;
2. their premises are acceptable, believable, warranted;
3. their premises together constitute sufficient grounds for the truth of the conclusion; and
4. they provide an effective rebuttal to all reasonable challenges to the argument's conclusion

Arguments that satisfy these criteria are "good" ones and we should accept their conclusions. By extension, arguments that fail to satisfy these criteria are "bad" arguments and we should not accept the conclusions of such arguments.

We can fulfill our consultations to provide biological opinions and other consultation documents that are legally-defensible — that is, conclusions that are not arbitrary or capricious — by consciously treating them as arguments. If those arguments satisfy the criteria, criteria of good arguments, we will have provided conclusions that should be accepted because they are rational, supported by the available evidence, and more rational than alternative conclusions. If our consultation documents do not satisfy these criteria, we will have failed to articulate a rational connection between the facts that were found and the conclusions we reached (which probably fails to satisfy the last APA criterion). In the latter case, our conclusions may be arbitrary or capricious.

This study guide is intended to help consulting biologists argue well. It begins by discussing the role of consultations in the process of building the arguments the Services must provide to support our conclusions. This discussion is followed by a detailed exploration of the criteria of arguments, generally, and good arguments in particular. The study guide then discusses the special requirements of causal arguments, which are important to any consultation.

At the same time, this study guide has important limitations. This study guide is designed to supplement the materials presented in the Advanced Section 7 class, it was not designed as a textbook on argumentation or the different philosophies of logic, the different practices and methods associated with those philosophies, rhetoric, or critical reasoning. Readers interested in gaining more depth in any of these subjects should refer to the list of references contained in the Further Reading section at the end of the guide.

2.0 The Role of Consultation in Developing Arguments

The Services consult with other federal agencies to identify the potential consequences of federal actions on listed species and designated critical habitat and help resolve those conflicts. Ideal consultations represent objective inquiries to identify an Action's potential direct and indirect effects on listed resources. As objective inquiries, consultations should adhere to the general principles of intellectual inquiry: the fallibility principle, the truth-seeking principle, the clarity principle, and the burden of proof principle.

Although they may not be achievable in particular consultations, these principles would create the conditions that would result in ideal section 7 consultations because their presence or absence in a consultation will reflect the degree of cooperativeness among the parties to a consultation. When the different participants approach a consultation with these principles, the consultation will contain a high degree of cooperativeness. When the different participants approach a consultation without these principles, the consultation will contain a low degree of cooperativeness or it may be adversarial. Regardless of the attitudes of other participants, Service representatives should always strive to apply these principles when they engage in consultations.

2.1 The Fallibility Principle

Fallibility represents an honest recognition of the limits of human understanding and knowledge of the world in which we exist; that time and future evidence may demonstrate that any human idea, conclusion, or proposition may turn out to be incorrect regardless of how rational the idea, conclusion, or proposition may seem when it is articulated. This principle requires us to accept that we may be wrong about our ideas, conclusions, or propositions, regardless of the care we put into developing them.

Section 7 of the ESA and its implementing regulations recognize the fallibility of consultation. The original language of section 7(a)(2) of the ESA required federal agencies to insure that their actions "will not" jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. That standard required the Services to be certain and highly confident of their conclusions, a standard that the Services and federal agencies had difficulty achieving.

In 1979, Congress amended section 7(a)(2) of the ESA to require federal agencies to insure that their actions "are not likely" to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat[3]. These amendments also required the Services and federal agencies to use the best scientific and commercial data available to reach conclusions in consultations. The 1986 regulations followed this reasoning to their logical conclusion by requiring the Services and federal agencies to reinitiate formal consultation when new information reveals effects of an action that may affect listed species or critical habitat in a manner or to an extent not previously considered[4].

These changes to the original consultation process accept that consultations are fallible: that the conclusions of consultations depend on the evidence available to the Services and federal agencies during a consultation. As a result, any consultation can produce conclusions that are rational at the time of a consultation, but may be incorrect in the face of new evidence. Therefore, during a consultation, the Services, Action Agencies, and Applicants must acknowledge that their starting positions may not withstand rigorous examination of the evidence available and that future evidence may cause them to reach different conclusions.

2.2 The Truth-Seeking Principle

In an effective consultation, participants should be committed to the task of searching for the true consequences of an Action on listed resources (at least they should be committed to searching for the consequences with the strongest support in the evidence available). Therefore, participants in consultations should be willing to seriously examine alternative positions, look for insights from other participants, and allow other participants to present arguments for or raise objections to any position or conclusion disputed in a consultation. The truth-seeking principle is essential to any objective inquiry because anyone who seeks the truth recognizes that they cannot discover the truth by ignoring counter-evidence.

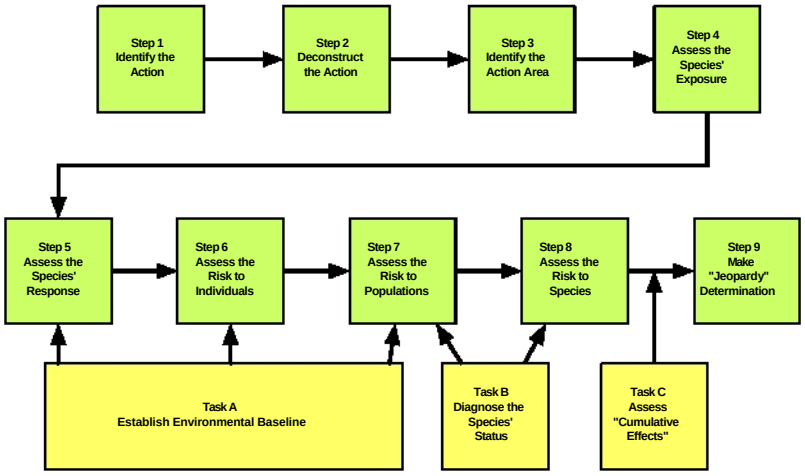
The truth-seeking principle is important to consultations because of the issues at risk in any consultation. If a consultation concludes that listed resources are likely to experience a particular consequence ("likely to be adversely affected," "likely to be jeopardized," etc) and that conclusion reflects the true experiences of the listed resources, then the consultation will have found the "truth," which we define as a statement that corresponds with the actual state of nature (cell (a) of the following table). The same would apply to consultations that correctly conclude that listed resources are not likely to experience particular consequences (cell (d) of the table).

		Listed Resources Actually Experience	
		Increased Risk	**No Increased Risk**
Consultation Outcome	**"Likely to"**	True Positive (a)	False Positive (b)
	"Not likely to"	False Negative (c)	True Negative (d)

[3] H.R. Conf. Rep. No. 697, 96th Cong., 1st Sess. 12 (1979)

[4] 50 CFR 402.16(b)

Figure 1. An illustration of the steps of the assessment framework for section 7 consultations showing the various steps of a consultation process



The same is not true of consultations that conclude that listed resources are not likely to experience particular consequences when, in fact, those consequences are likely (cell (c) of the table). In these circumstances, consultations fail to protect listed resources when protection is warranted. These consultations place listed resources at greater risk of extinction. Conversely, consultations that conclude that listed resources are likely to experience particular consequences when, in fact, those consequences are not likely (cell (b) of the table) protect listed resources when protection is not warranted. These consultations are likely to impose requirements on Action Agencies, Applicants, or both, when such requirements are not necessary.

2.3 The Clarity Principle

In a consultation, as in any argument, we need to make certain that our assertions, defenses, and attacks should be free of linguistic confusion or vagueness. For the same reasons, assertions should be separated from one another to avoid creating complex arguments. This is a important principle to remember, particularly because many Action Agencies, Applicants, and other observers have viewed consultations as black boxes resulting from vague terminology, indefinite standards, and opaque process.

The terminology associated with the assessment framework presented in this class (see Figure 1) and the framework itself are designed to provide the clarity that is essential to an inquiry that involves several participants. For example, the Services' prior use of the term "effect" is ambiguous because an "effect" can represent the consequences of an Action on the environment of an Action Area, the exposure of threatened or endangered species to those consequences, the response of threatened or endangered species given their exposure, the risks those responses represent to the species, or any combination of these alternatives. Introducing the terms "exposure," "response," and "risk" into the lexicon of consultation and treating each as a separate, logical step eliminates potential confusion or vagueness that might exist without them. At the same time, the analyses

associated with the different steps of the assessment framework are designed to eliminate some of the general confusion and ambiguity that surrounded section 7 consultations themselves.

In any consultation, the Services need to remember the numerous technical terms associated with consultation, ecology, and related sciences. Many of these terms have many different technical definitions or technical definition that are different from common usage (think of terms like "habitat," "ecosystem," or "take"). Any of these terms can become sources of confusion in consultation and the Services should always be prepared to clarify those terms for Action Agencies, Applicants, and other participants in consultations.

2.4 The Burden of Proof Principle

As in any argument, each participant in a consultation is responsible for explaining the reasoning and evidence (premises) supporting their position and for defending that position. To comply with this principle, Action Agencies and Applicants (if any) are responsible for providing details about proposed Actions, the purpose of a proposed Action, the statutory authority, etc. as well as any reasons and evidence supporting any "no effect," "not likely to adversely affect," or "likely to adversely affect" determinations they may have reached in other phases of a consultation. Similarly, the Services are responsible for providing the reasons and evidence supporting any conclusions we reach in any phase of a consultation on an Action.

3.0 Argument

As discussed in the Introduction to this Study Guide, the term "argument" is "a group of statements (premises) that provide rational support or evidence for another statement (the conclusion). Another definition of argument is "a conclusion or judgment that results from reasoned reflection of evidence." The following example from a biological assessment illustrates a basic argument

Example 1

The proposed bridge replacement will be completed between September 15 and November 1. The least Bell's vireo nesting season typically occurs in the spring and summer, between March 15 and September 15. Because the project will occur outside of the species' nesting season, noise from construction activity will not disturb nesting birds.

The concluding statement (conclusion) of this paragraph is "noise from construction activity will not disturb nesting birds" (least Bell's vireos). The reason (premise) that is offered to explain why this conclusion is rational is "the project will occur outside of the vireo's nesting season." The other statements (premises) represent evidence that makes a reader more likely to accept the reason: (a) the bridge replacement will be completed between September 15 and November 1 and (b) least Bell's vireo typically nest between March 15 and September 15.

If a statement appears without explicit or implicit reasons or evidence to support it, then the statement is not an argument. The statement may articulate an opinion or position, but it is not an argument unless it is supported by reason or evidence. At the same time, an "opinion" (as that term is used in normal conversation) becomes an "argument" when it is supported by reasons or evidence (in normal conversation, we might call this a "reasoned opinion"). In that sense, biological opinions are not "opinions," as that term is commonly defined, they are arguments: conclusions

resulting from reasoned reflection of the available evidence. Similarly, most of the documents associated with section 7 consultations represent arguments:

- the conclusions of biological assessments (an Action Agency must *conclude* that their action is or is not likely to adversely affect listed resources and provide reasons and evidence to support for their conclusion)
- requests for formal consultation (an Action Agency has *concluded* that their action "may affect" or "is likely to adversely affect" listed resources and provide reasons and evidence to support their conclusion as part of their request for consultation)
- the conclusions of the Service's concurrence or non-concurrence letters (the Services *conclude* that we can accept or reject an Action Agency's "likely to adversely affect" or "not likely to adversely affect" conclusion and we must provide the reasons and evidence that support those conclusions)

4.0 Attributes of Good Arguments

As a general matter, an argument should resolve an issue in dispute if the reasons and evidence supporting the argument's conclusions can be successfully defended by an argument that uses (a) relevant and (b) acceptable premises that together (c) provide sufficient grounds to support the conclusion and (d) constitute an effective and stronger rebuttal to the alternative. Good arguments, which are designed to find the truth of and resolve issues in dispute, have all of these four attributes: their premises are relevant, their premises are acceptable, their premises provide sufficient support for their conclusions, and they rebut counter-arguments and other challenges. Arguments that do not satisfy these four criteria are not good arguments and we should not accept their conclusions as given. The following narratives explore these different criteria in more detail.

4.1 Relevance Criterion

To comply with the relevance criterion, arguments for or against a conclusion should contain only reasons and evidence that are directly related to a particular conclusion. This does not mean that every piece of information we provide in consultation must be relevant to a particular conclusion. Some of the information the Services include in our biological opinions and concurrence letters (or Action Agencies include in their biological assessments) are offered as background or provide context for Action Agencies, Applicants, and other readers. However, background or contextual information are rarely reasons or evidence that support a particular conclusion.

Reasons and evidence offered in support of particular conclusions — whether those conclusions are designed to establish a species' status, the impact of an environmental baseline, or a species' response to a habitat change — should be relevant to the conclusion they are designed to support.

What reasons or evidence are irrelevant to a conclusion in a consultation? At a minimum, reasons or evidence representing issues that Congress did not intend us to consider in a consultation (for example, political or economic reasons) would be irrelevant to our conclusions in a consultation and would fail to satisfy the relevance criterion. Mitigative measures might also be irrelevant to the conclusion of a consultation if (a) their benefits are likely to be realized long after the species they are intended to benefit is likely to be extinct or (b) they benefit the most robust populations of a species while the action they are associated with harms populations that cannot withstand further

disruption. Similarly, a biologist's personal feelings about the merits (or lack thereof) of an action or an Action Agency's personal feelings about the merits of protecting a listed species often form premises that are irrelevant to the conclusions of a consultation.

4.2 Acceptability Criterion

To comply with the acceptability criterion, arguments for or against a conclusion should use reasons and evidence that we can accept as factually true (see Box 1). If a premise is false, it would be unacceptable. The following example illustrates this criterion

Example 2

A power company argues that modifying operations to a run-of-the-river flow regime will adversely affect bald eagles. The company cites studies that identify bald eagles downstream from the dam eating suckers killed when the river below the dam is dewatered. The company concludes that if the river is never dewatered, the suckers will not die, and the bald eagles will starve.

One premise of this argument is not stated, but is critical: bald eagles only eat dead suckers. This premise is unacceptable because it is false. Without this premise, the company has not support for its conclusion. Its options are to revise the conclusion to conform with the evidence, provide other reasons or evidence that might support its conclusion, or offer the conclusion as unsupported opinion or speculation.

Premises should be acceptable if they have any of these attributes in Box 1.A. Premises would be unacceptable if they have any of the attributed in Box 1.B. Returning to Example 2, the premise implicit in the company's argument has attributes B.1, B.2, B.4 and B.7. This example also illustrates the best way of defeating an argument while remaining rational in the process: demonstrate that one or more of the premises necessary for a conclusion are false or unacceptable rather than challenge the argument's conclusion.

4.3 Sufficiency Criterion

To comply with the sufficiency criterion, arguments for or against a conclusion or proposition should provide reasons and evidence that are sufficient in number, kind, and weight to support the acceptance of the conclusion or proposition. In any argument, this is probably the most difficult criterion to satisfy because the reasons and evidence that would be sufficient to support one conclusion may not be sufficient to support another conclusion. Usually, there is no single or simple answer to the question "When are my reasons and evidence sufficient to support my conclusion?"

It is often easier to explain when reasons and evidence would not be sufficient in number, kind, and weight to support a conclusion. If we base a conclusion on a *portion* of the available evidence (for example, only the evidence that supports conclusion or evidence that does not support the conclusion), rather than the *totality* of that evidence, our argument would not satisfy the sufficiency criterion (it might also fail to satisfy the rebuttal criterion as well because someone could offer the evidence we omitted or neglected to support their counter-arguments).

When presenting an argument to support a jeopardy determination, for example, it may be sufficient to present evidence of biologically important reductions in a species' abundance or increases

Box 1. List of criteria that determine when we should accept premises as acceptable (A) or reject them as unacceptable (B)

A. Criteria of Acceptable Premises	**B**. Criteria of Unacceptable Premises
1. A claim that is a matter of undisputed common knowledge or accepted scientific practice or principle; 2. A claim that represents a literal interpretation of federal law, regulation, agency policy, or uncontroverted opinion from a federal court of law; 3. A claim that is adequately defended elsewhere in the record of a consultation, final NEPA documents associated with an action under consultation, or other agency documents developed to support its official record on an action; 4. A claim or conclusion that is supported by the best scientific and commercial data available; 5. An uncontroverted report in an paper in a peer-reviewed journal article; 6. A claim that is a statement of facts from a biologist's personal knowledge, observation, or data; 7. A relatively minor claim that one has no reason to question and that seems to be a reasonable assumption in the context of the argument presented to support the conclusion of a consultation.	1. A claim that contradicts the evidence, a well-established claim, accepted scientific practice or principle, or a credible source; 2. A claim that is inconsistent with one's own personal knowledge or observations; 3. A claim that contradicts other premises of the argument or the conclusions of other documents reviewed during a consultation (for example, NEPA documents); 4. A questionable claim that is not adequately defended by the best scientific and commercial data available; 5. A claim that is linguistically confusing 6. A claim that is no different from the conclusion that it is used to support; 7. A claim that is based on a usually unstated but highly questionable assumption.

in a species' declining trend while ignoring evidence of increased variance in the species' abundance or trend. Based on the literature available on factors that contribute to a species' extinction risk, population abundance and trend explain most of a species' risk of extinction. Given that literature, variance should always increase a species' extinction risk so ignoring variance would not necessary lead to a false jeopardy conclusion. By extension, an argument that supported a jeopardy conclusion *could* safely ignore variance and still be sufficient to support its conclusion (the different population variables that are known to contribute to the extinction risks of different species are discussed further in the Risk Analysis Study Guide).

At the same time, a "no jeopardy" argument that relied on changes in a species' abundance and trend, but ignored changes in variance in population abundance and trend would probably underestimate a species' actual extinction risks. Therefore, an argument supporting a "no jeopardy" conclusion *could not* safely ignore variance in population abundance and trend and still be considered sufficient to support its conclusion.

A large body of knowledge is available that would help the Services establish that our reasons and evidence are sufficient to support our conclusions in section 7 consultations: prior consultations; prior cases of species and populations that have declined, collapsed, or become extinct; and the

body of scientific knowledge on the response of natural populations to human activities. For example, there are numerous quantitative and qualitative studies of how changes in variables that define a population's ecology contribute to a species' or population's extinction risk (for example, see Dennis *et al*. 1991; Fagan *et al*. 1999, 2001; O'Grady *et al*. 2004. Also see Risk Analysis Study Guide). These studies provide examples of changes in population variables that are suffi- cient to increase the extinction risks of many species of plants and animals (and since they are published in peer-reviewed journals, they should meet the criterion of acceptability).

The Services should rely on these data to help establish the sufficiency of the reasons and evidence we present in particular consultations. The Services should also rely on the large number of consultations we have conducted on different federal actions (including the incidental take statements contained in the biological opinions that concluded these consultations), monitoring reports from those consultations, and documents associated with federal, state, local, and private endangered species programs (recovery actions, status assessments, conservation plans, etc.) to establish the sufficiency of the reasons and evidence that support their conclusions.

4.4 Rebuttal Criterion

To comply with the rebuttal criterion, arguments for or against a conclusion or proposition should effectively rebut all strong challenges or counter-arguments. An argument is a strong challenge or counter-argument when it provides reasons and evidence that are relevant to the conclusions of the counter-argument and that may be acceptable and sufficient to support the counter-argument's conclusions.

We can return to Example 2 (Page 8) to illustrate the role of the rebuttal criterion in argument,

> A power company argues that modifying operations to a run-of-the-river flow regime will adversely affect bald eagles. The company cites studies that identify bald eagles downstream from the dam eating suckers killed when the river below the dam is dewatered. The company concludes that if the river is never dewatered, the suckers will not die, and the bald eagles will starve.

If the power company wanted to improve its argument, it would have recognized the implicit premise necessary to support their conclusion (their conclusion is valid if and only if bald eagles eat only dead suckers), anticipated an obvious counter-argument (bald eagles eat more than dead suckers), and provided reasons and evidence to rebut this counter-argument.

In most consultations, Action Agencies or Applicants have arguments that counter the Services' arguments, even though the Services may not recognize those counter-arguments. For example, when the Services do not concur with an Action Agency's "not likely to adversely affect' determination, the Action Agency's conclusion remains a counter-argument that warrants a rebuttal. When the Services issue a "no jeopardy" or "jeopardy" biological opinion, there are often strong argu- ments that support the alternative "jeopardy" or "no jeopardy" conclusions. In each of these in- stances, the Services increase support for our conclusions when we acknowledge the arguments that support these alternative conclusions, analyze and evaluate those arguments, and provide reasoned responses to them.

The purpose of rebutting an argument is to demonstrate that argument in support of our conclusion or proposition has greater support in reasons and evidence than the arguments that would lead to alternative conclusions. If we are objective in our evaluation of the arguments that support alternative conclusions, we must also accept that those arguments may, in fact, be stronger than our own arguments. In that instance, when we rebut counter-arguments, we should be open to the possibility of having to accept the conclusion the counter-argument supports.

The record supporting biological opinions or concurrence letters should demonstrate that the Services considered arguments (reasons and evidence) that support alternatives to the conclusion we have provided. The record should also demonstrate that the conclusion we reached had the greatest support in the best scientific and commercial data available.

5.0 Reconstructing Arguments

Because people tend to accept conclusions or assertions that agree with their prior beliefs and reject conclusions or assertions that do not agree with those beliefs, to evaluate an argument objectively, we cannot be concerned about whether we are inclined to believe a conclusion or claim. Our sole concern must be whether it is rational to believe or accept the conclusion on the grounds provided by the argument. Often, the most difficult part of evaluating an argument is suspending our prior beliefs and focusing on the argument actually presented to support a conclusion instead of on the conclusion itself.

Evaluating arguments can also be difficult because most authors, in their normal writing, don't clearly identify their premises and their conclusions. Some authors identify their conclusions with words like "therefore," "in conclusion," "as a result," etc. (sometimes these words introduce sen- tences unconnected to an author's true conclusion), but most authors usually don't explicitly high- light the reasons or evidence that support their conclusion. Further, most authors include informa- tion that does not support their argument, but is offered as background material or context for the argument. Nevertheless, to evaluate any argument we need to identify an argument's conclusion(s) and distinguish the conclusion from the reasons and evidence offered to support the conclusion.

Reconstructing arguments into what is called "standard form" makes it easier to distinguish an argument's premises from its conclusion; it also makes it easier to eliminate background and other material that is not necessary to support a conclusion (and that often disguises a conclusion). The standard form of arguments looks like

1. Premise 1
2. Premise 2 3.
   Premise 3

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4. **So**: conclusion

This example illustrates several traditions associated with presenting arguments in standard form. First, each premise is normally listed separately and numbered to make it easier to discuss the premises while evaluating the argument. Second, the conclusion is normally separated from the premises by a ruling line (an "inference bar"). Third, the conclusion is normally introduced with a

term like "Therefore" or "So" (in this text, we will introduce conclusions with the term "So:" highlighted in bold and separated by a ruling line to distinguish it from other premises).

Finally, different arguments will have different numbers of premises. Although this example of an argument in standard form has three premises, there is no particular limit in the number of premises an argument might contain. Some arguments may only have one premise, other arguments may have tens or hundreds of premises (depending on how you count its premises, the U.S. Declaration of Independence has 31 premises supporting its conclusion). It is also traditional to include a premise that explains how and why the reasons and evidence presented in the argument combine to provide rational support for the conclusion (we illustrate this in the next example).

It takes practice to reconstruct arguments, but standard form has several benefits over normal prose. In addition to making it easier to evaluate arguments, reconstructing arguments in standard form protects us against our biases, particularly our tendency to accept conclusions that confirm our prior beliefs and reject those that do not. By forcing us to examine the structure of an argument without the surrounding prose, reconstructing arguments in standard form helps us see past the strength of an author's words to examine the strength of the author's argument.

When we reconstruct arguments, particularly arguments we may not agree with, the **Principle of Charity** is important: we need to *present an argument in the strongest possible form that is consistent with the original author's purpose*. If we are uncertain about an author's intentions in an argument or think parts of their argument are implicit, we must give the author the benefit of the doubt when we reconstruct their argument. For example, if an argument includes implicit premises, we should include those premises in our reconstruction, but enclose our addition in parentheses to distinguish it as something we have added.

We illustrate the process of reconstructing an argument in standard form using an argument from the Consultation Handbook (page 3-8):

> **Example 3**
>
> Inasmuch as distributional information on many rare species is incomplete or imprecise, it is not currently possible to provide a definitive finding relative to small whorled pogonia in the permit area. Therefore, in situations such as this, where an endangered species is known to occur in similar habitats nearby, a qualified botanist should survey the following proposed alignments prior to construction activities: alignment sections with corresponding numbers 11 - 20 (no Figure identified) and Nos. 37 - 39 (Fig. 35). A survey for the small whorled pogonia should be conducted by a botanist familiar with this species and should occur in July or August to ensure best survey conditions.

This paragraph contains a very specific conclusion ("Therefore,... a qualified botanist should survey the following proposed alignments....") that is supported by several reasons and evidence presented in the different sentences of the paragraph. So the paragraph contains all elements required of an argument. The paragraph also contains another feature of arguments called a connecting premise or warrant: a statement of general circumstances from which the Services make a general inference (this circumstance is captured in the second sentence of the paragraph "...in situations such as this, where an endangered species is known to occur in similar habitats

nearby...."). Warrants do not always appear in every argument, but they can provide more support for an argument's conclusions when they appear in an argument.

The argument contained in this paragraph, reconstructed in standard form, appears as.

1. Since distributional information on many rare species is incomplete or imprecise
2. and the Service cannot conclude that small whorled pogonia do not occur in the permit area
3. and small whorled pogonia are known to occur near the permit area
4. and small whorled pogonia occur in habitat similar to those in the permit area
5. (when distributional information on a threatened or endangered species is incomplete, and the Services cannot rule out a species' occurrence in an Action Area because the species is known to occur near an Action Area, and is known to occupy habitats similar to those in an Action Area, an Action Agency should conduct surveys by qualified personnel to determine whether the species occurs in the Action Area)

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6. **So:** a qualified botanist should survey the following alignments prior to construction activities

Example 3 (above) illustrates the reconstruction of an argument that appeared in a consultation into standard form. Premise 5 of this reconstruction illustrates the practice of enclosing an additional premise in parentheses to distinguish it as something we have added. The statement in parentheses is not part of the original text; it is included in the reconstructed argument because it explains why the other premises constitute reasons for the conclusion. Without this premise, readers may not understand how to think about the problem; how and why the reasons and evidence contained in the other premises provide rational support for the conclusion.

Also note that Premise 5 of the reconstructed argument does not represent an explicit premise of the original argument, but provides an explanation of why the other premises are good reasons for accepting the conclusion. This kind of premise is often called a "warrant": a premise that explains why the other reasons and evidence combine to form a satisfactory reason for accepting an argument's conclusion. We can also think of warrants as "conceptual models" of arguments; they iden- tify how reasons and evidence combine to support a conclusion. Some arguments require explicit warrants while others do not; the more complex an argument or the more complex the subject matter of an argument, the more important a warrant becomes.

Once we have reconstructed an argument in standard form, we then evaluate the argument using the four criteria of a good argument:

1. their premises are relevant to the truth of the conclusion;
2. their premises are acceptable, believable, warranted;
3. their premises together constitute sufficient grounds for the truth of the conclusion; and
4. they provide an effective rebuttal to all reasonable challenges to the argument's conclusion

To evaluate an argument, first eliminate any premises that are not relevant to the conclusion (supported by an explanation of why those premises are not relevant). Then we eliminate any of the

remaining premises that are not acceptable (supported by an explanation of why they were considered unacceptable). Finally, we decide whether the reasons and evidence that remain are sufficient to accept the conclusion. If they are not, then we should reconsider the conclusion.

If our reasons and evidence are sufficient to support our conclusion, then we must rebut challenges to our argument or our conclusion. We use the same procedure when we prepare a rebuttal: reconstruct the counter-argument in standard form, remove premises that are not relevant and any premises that are not acceptable (with explanations of why any premises have been removed). Then we decide whether the reasons and evidence that remain are sufficient to accept the conclusion. When we decide that the premise of a counter-argument is not relevant or acceptable, or that the premises are not sufficient to support the argument's conclusion, the reasoning that supports these decisions forms our rebuttal to the counter-argument.

If we concluded that a counter-argument was sufficiently strong even after our rebuttal, we could compare the sufficiency of the argument that supports our proposed conclusion with the sufficiency of the argument that support alternative conclusions. Using a "strength of evidence" approach to section 7 determinations (jeopardy/no jeopardy; destruction or adverse modification/no destruction or adverse modification), the conclusion that has the strongest supporting argument should form the basis for our determination. That is, we should consider a consultation resolved if the reasons and evidence supporting one of four possible outcomes — "jeopardy" or "no jeopardy"; "destruction or adverse modification" or not — can be successfully defended by an argument that uses relevant and acceptable premises that together provide sufficient grounds to support the conclusion and provides an effective and stronger rebuttal to the alternative.

Unless someone — Action Agency, Applicant, or other parties to a consultation — demonstrates that these conditions have not been met, they should accept the conclusion of a consultation and consider the issue to be settled for all practical purposes. In the absence of a successful argument for an alternative conclusion, a rational person will accept the conclusion that is supported by the best of the arguments presented.

Example 4: An Argument From a Technical Assistance Letter

A paragraph from a technical assistance letter issued by the U.S. Fish and Wildlife Service illustrates the process of reconstructing an argument and evaluating it using the four criteria we have just discussed: the relevance criterion, acceptability criterion, sufficiency criterion, and rebuttal criterion. In its original form, the paragraph appeared as

Example 4

Streambank and riparian damage caused by grazing livestock has affected and continues to impact Lahontan cutthroat trout. For example, a recent survey found many stream reaches had raw, actively eroding cutbanks and little riparian vegetation. Excessive grazing within the riparian area can lead to increased sedimentation, which causes mortality of embryos and fry through suffocation in the substrate. The proposed action will allow grazing in riparian areas within the range of the Lahontan cutthroat trout. Therefore, continued grazing is likely to adversely affect Lahontan cutthroat trout through mortality of embryos and fry.

This paragraph contains two arguments that support two different conclusions. The first argument is

1. A recent survey found many stream reaches had raw, actively eroding cutbanks and little riparian vegetation
2. (Since actively eroding cutbanks and little riparian vegetation is evidence of streambank and riparian damage caused by livestock)
3. (and since eroding cutbanks and little riparian vegetation is evidence of increased sedimentation in streams that impacts Lahontan cutthroat trout)

---

4. **So**: Streambank and riparian damage caused by grazing livestock has affected and continues to impact Lahontan cutthroat trout

This argument appeared to have been intended to demonstrate that livestock grazing results in streambank erosion and damage to riparian vegetation which results in increased sedimentation that has adverse consequences for Lahontan cutthroat trout. The nature of the statement suggests that this argument paints a general picture of threats to the trout generally. Applying the principle of charity to the first argument, we needed to add two premises that were implicit in the original statement. Following tradition, both of the implicit premises are enclosed in parentheses.

The second argument, which is specific to a particular action, would be reconstructed as

1. The proposed action will allow grazing in riparian areas within the range of Lahontan cutthroat trout
2. Excessive grazing in riparian area can cause increased sedimentation
3. Increased sedimentation can suffocate embryos and fry causing mortality

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4. **So:** The proposed action is likely to adversely affect Lahontan cutthroat trout

Both of the premises initially appear to be relevant to the conclusion. Premises 2 and 3 of the reconstructed argument — excessive grazing can increase sedimentation and increased sedimentation can suffocate and kill embryos and fry — do not satisfy the acceptability criterion. Both Premises 2 and 3 may be true (and, therefore, acceptable) as general statements, they are not necessarily true (and, therefore, not necessarily acceptable) in this particular case. That is, while Premise 2 may be true when grazing is "excessive," it does not follow that it is true when grazing is not "excessive." While Premise 3 may be true for some level of increased sedimentation, it does not follow that it is true at any level of increased sedimentation.

In addition, both premises deal with possibilities ("excessive grazing *can* increase sedimentation"; "increased sedimentation can suffocate embryos....") which do not provide sufficient grounds for believing that increased sedimentation is *probable* or that the increased sedimentation as a result of the proposed action is *likely* to be sufficient to suffocate or kill young fish. To support premise 3, the argument would have to establish that increased sedimentation associated with the proposed action would be sufficient to suffocate and kill young fish given ambient levels of suspended sediment. As a result, these two premises might be sufficient to support a conclusion that asserts only possibility (that is, "may affect"), but they are not sufficient to support a conclusion that asserts probability ("likely to adversely affect"). We could also use this reasoning to argue that both premises are not relevant because they do not constitute reasons or evidence for the conclusion.

Finally, the argument does not satisfy the rebuttal criterion because of these problems. As given, it does not rebut challenges to the acceptability or sufficiency of its premises. As a result, an Action Agency or Applicant could build a counter-argument on more acceptable premises that would be sufficient to support an argument for the opposite conclusion: the proposed action "may affect" but is "not likely to adversely affect" listed resources.

We would not call this a good argument. It would have to be supplemented with additional reasons or evidence to support its conclusion. The argument would need to (a) be supplemented by additional premises that establish the probability of the consequences they assert or (b) have its conclusion revised to "may" rather than "is likely." If additional premises could not be added so that the argument's conclusion was rational, then the conclusion should change to "possible, but not likely" to make it compatible with the available evidence.

Example 5: An Argument From a Biological Opinion

Another example uses a conclusion from a "no jeopardy" biological opinion to illustrate the process of reconstructing and evaluating arguments. In its original form (the original text has been modified to make the text somewhat anonymous), the conclusion appeared as

Example 5

After reviewing the best available scientific and commercial information regarding the biological requirements and the status of the listed coho salmon considered in this Opinion, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, NOAA Fisheries concludes that the action, as proposed, is not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify designated critical habitat.

These conclusions are based on the following considerations: (1) Action Agency will use Integrated Pest Management to ensure that a combination of all available pest control strategies, including pesticide alternatives, are applied to keep pests below treatment thresholds while reducing the need for pesticide applications; (2) when chemical use is required, Action Agency will select the pesticide formula that is least toxic for fish and aquatic life while achieving management needs; (3) the application of chemicals will be timed to coincide with weather conditions that are least likely to result in riparian and aquatic contamination; (4) broad non-spray buffers will be observed to reduce the likelihood of significant quantities of pesticide will be transported to riparian and aquatic systems through drift, surface runoff, and groundwater runoff; (5) chemicals will be applied using precise methods designed to reduce the amount of pesticide loss; (6) a comprehensive sampling, monitoring, and analysis protocol will be used to ensure that the behavior and transport of chemicals in the environment are as predicted; (7) the proposed action includes an explicit process to quickly modify the proposed action based on any significant new information that may be developed through consultations now underway with EPA regarding the effects of pesticides proposed for use during management of the land management area; and (8) all fertilizer applications will be applied at environmentally optimum rates designed to reduce the presence of fertilizer products in drainage water delivered to surface and groundwater systems.

Box 2. Reconstruction of the argument presented in Example 5 (supporting the conclusion of a biological opinion for threatened coho salmon) reconstructed in standard form. See the text for an evaluation of this argument.

1. The Action Agency proposes to use pesticides, fungicide, herbicides, and fertilizers over a five-year period as part of its management of a seed orchard
2. and the Action Agency proposes to reduce the probability of exposing listed coho to these pesticides, fungicide, herbicides, and fertilizers and a reduced forage base by using Integrated Pest Management to reduce the need for pesticide applications; selecting the pesticide formula that is least toxic for fish and aquatic life; timing its application of chemicals to coincide with weather conditions that are least likely to contaminate riparian and aquatic areas in the Action Area; observing broad non-spray buffers to reduce the likelihood of significant quantities of pesticide being transported to riparian and aquatic systems through drift, surface runoff, and groundwater runoff; applying chemicals using precise methods designed to reduce the amount of pesticide loss; implementing a comprehensive sampling, monitoring, and analysis protocol to ensure that the chemical's fate and transport occurs as predicted; modifying their chemical application based on significant new information generated by consultation with the Environmental Protection Agency; timing its application of chemicals to coincide with weather conditions that are least likely to contaminate riparian and aquatic areas in the Action Area [a conclusion supported by the Description of the Proposed Action]
3. (when an Action Agency proposes to use Integrated Pest Management to reduce the need for pesticide applications; selecting the pesticide formula that is least toxic for fish and aquatic life; times its application of chemicals to coincide with weather conditions that are least likely to contaminate riparian and aquatic areas in the Action Area; observes broad non-spray buffers to reduce the likelihood of significant quantities of pesticide being transported to riparian and aquatic systems through drift, surface runoff, and groundwater runoff; applies chemicals using precise methods designed to reduce the amount of pesticide loss; implements a comprehensive sampling, monitoring, and analysis protocol to ensure that the chemical's fate and transport occurs as predicted; modifies its chemical application based on significant new information generated by consultation with the EPA; times its application of chemicals to coincide with weather conditions that are least likely to contaminate riparian and aquatic areas in the Action Area to reduce the probability of exposing listed species to pesticides, herbicides, and fertilizers, the Action is not likely to appreciably reduce the likelihood of both the survival and recovery of listed coho salmon in the wild by reducing their reproduction, numbers, or distribution)
4. **So**: the Action Agency's proposal to use pesticides, fungicide, herbicides, and fertilizers over a five-year period as part of its management of a seed orchard is not likely to jeopardize the continued existence of listed coho in the wild by reducing the reproduction, numbers, or distribution of listed coho salmon

The first paragraph of the original explanation is standard language from the Consultation Handbook which reinforces the Services' regulatory obligation to consider a listed species' status, the environmental baseline of an action area, the effects of an action (as defined in regulation), and cumulative effects when reaching a conclusion in an opinion. The second paragraph of the text provides the argument that supports the "no jeopardy" conclusion.

Since the variables mentioned in the first paragraph — the species' status, the environmental baseline of the action area, etc. — were not offered as either explicit or implicit premises that informed the "no jeopardy" conclusion, they are not included in the reconstructed argument (Box 2, page 17) rather than as premises of the reconstructed argument itself (because they are not included, they are treated as background information for the argument). Consistent with the principle of charity, other versions of the reconstructed argument included these variables, but their inclusion had no effect on the acceptability of the conclusion.

Although the third premise of the reconstructed argument is only a minor modification of the second premise, the details were included to comply with the principle of charity because the argument implies that the second premise is a good reason for accepting the conclusion because the set of mitigative measures reduce the probability of exposing coho salmon to toxic chemicals and that reduction is sufficient to avoid the jeopardy outcome. We could have plausibly written Premise 3 as

> When an Action Agency proposes measures that reduce the probability of exposing listed species to an Action's effects on the environment, the Action is not likely to appreciably reduce the likelihood of both the survival and recovery of listed coho salmon in the wild by reducing their reproduction, numbers, or distribution

but that reconstruction would be obviously false (it does not follow that proposing to reduce the probability of exposing threatened or endangered species to an Action's effects on the environment renders an Action unlikely to jeopardize those species) and very easy to reject as unacceptable. As a result, such a reconstruction would not satisfy the Principle of Charity. The reconstruction in Box 2 is charitable because the premise may not be generally true, but might be true because the specific measures are, in fact, sufficient to insure that the set of pesticides, herbicides, fungicides, and fertilizers the Action Agency proposes to use are not likely to jeopardize the continued existence of listed coho salmon. This premise may not be true or acceptable in its generalized form, but it may be true or acceptable in its specific form, which is why the premise is presented in the latter form to satisfy the principle of charity.

We leave readers to decide if this premise is still acceptable. If it is acceptable, is it sufficient to support the arguments conclusion? If it is not acceptable, does the argument provide sufficient reason to support its conclusion?

Reconstructing arguments in standard form is useful for several reasons. First, it clears the argument of material that does not support a conclusion and often disguises a good argument. Second, using standard form makes it easier to discover where an author didn't provide sufficient evidence to support a conclusion. Finally, the practice of reconstructing arguments in standard form and examining them helps us distinguish good arguments from poor ones. The more we practice this part of argumentation, the better we become at developing our own arguments. Arguments fall into certain patterns. By first composing our arguments in standard form, we can make sure they follow one of the correct patterns before inserting them into the text of our biological opinions.

8.0 Causal Argument

The Services, Action Agencies, and Applicants have to offer, rebut, and defend causal arguments at almost every step of a consultation. Indirect effects, which are effects "that are caused by the proposed action and are later in time, but still are reasonably certain to occur," are one of the few elements of a consultation that require the Services to make explicit causal arguments. In most other respects, causal arguments are implicit: developing the status of listed species requires the Services and Action Agencies to identify the causes of species' declines; developing environmental baselines for action areas require the Services and Action Agencies to identify the impacts "caused" by a suite of federal, state, or private actions; the response analyses prescribed by the risk assessment framework for jeopardy analyses are designed to identify the responses "caused" by a species' exposure to an action's stressors; incidental take statements require the Services to iden- tify the different forms of "take" that are unintentionally "caused" by federal actions.

Similarly, many of the conclusions of consultation implicitly assert that an action "caused" an "effect" or an intended or unintended consequence. When the Services conclude that an action "is likely to adversely affect" listed species or critical habitat, we are asserting that "the action is likely to *cause* effects that are likely to have adverse consequence for a listed species. When the Services conclude that an action is "likely to jeopardize a listed species," we are asserting that an action is not only adverse, it is expected to *cause* a threatened or endangered species to face an appreciably greater risk of extinction (or an appreciably lower risk of being conserved).

Causal arguments have different requirements than non-causal arguments for two primary reasons. First, our species (and other sentient species) do not observe or measure "causation," we infer "causation" from events we observe or measure. If we witnessed an automobile pile-up, we would observe a series of interactions between a number of drivers and their automobiles; from those observations, we might conclude that one or more of the participants "caused" the entire incident. In this instance, we would not observe an "event" called "causation," we would have inferred a cause from the events we had observed.

Second, psychologists have identified numerous biases in human perception of causal relationships. Our species tends to perceive events or conditions that occur immediately before an effect as causal rather than events that are separated from their effects. We tend to perceive events that occur as causal rather than events that do not occur. We tend to treat phenomena that are surprising as causal agents and ignore routine phenomena. We tend to focus on causal agents that confirm our assumptions rather than causal agents that do not. We look for causes whose magnitude is proportional to their effect. Finally, we tend to search for a single causal agent rather and often fail to recognize the causal role of sets of events or conditions.

These biases complicate the process of getting others to recognize the relevance of the premises of causal arguments, getting them to accept those premises, getting them to recognize when premises are sufficient and when counter-arguments have been successfully rebutted. For these reasons, causal arguments are more difficult to offer and defend than non-causal arguments.

Different applied sciences use various approaches for establishing or detecting causal relationships (that is, for relating causes to their effects) and making causal arguments about those relationships. We first discuss two concepts, "necessary conditions" and "sufficient condition," because of their

central role in causal discussion and causal argument. We conclude this section with a discussion of the standard form of causal arguments.

6.1 Cause as a "Necessary" Condition, a "Sufficient" Condition, or Both

The concepts "necessary condition" (or "necessary cause") and "sufficient condition" (or "sufficient cause") anchor most discussions of causal relationships regardless of whether they are actually mentioned in those discussions. A phenomenon is a "necessary condition" (or cause) for an effect when it must be present for an effect or consequence to occur. A phenomenon is a "sufficient condition" (or "sufficient cause") when its presence inevitably produces an effect or consequence.

Put another way, in the absence of a "necessary condition," an effect will not occur, even if the presence of the necessary condition does not make the effect inevitable (another causal agent might need to be present for an effect to occur). In the presence of a "sufficient condition" an effect will occur, even if the absence of the sufficient condition does not preclude the effect or consequence (the presence of another causal agent might still produce the effect). We can use "fire" to illustrate the meaning of these terms. Oxygen is a common example of a necessary condition for fire: in the absence of oxygen, fire will not occur, but the mere presence of oxygen is not sufficient for fire to occur.

1. A Causal Agent (C) is a Necessary Condition and a Sufficient Condition for Effect (E)

In this instance, a causal agent (C) and an effect (E) are always present together and nothing but that causal agent is needed to produce the effect. This circumstance is one of the most restrictive causal relationships because it describes a relationship in which one causal agent and only one causal agent produces a particular effect or consequence. We rarely encounter this kind of causal relationship in ecology or biology because most living systems evolved with redundant processes and pathways in order to adapt to changing environments. Unfortunately, many people consider this the only valid causal relationship.

2. C is a Necessary Condition but C is not a Sufficient Condition for E

In this instance, C must be present when E is present, but E is not inevitable when C is present. As a result, some additional factor(s) must also be present to produce the effect. The necessary condition is a pre-requisite for an effects, but other pre-requisite conditions are also necessary. Our earlier example of the causal relationship between oxygen and fire illustrates this circumstance. Oxygen is a necessary condition for fire; in the absence of oxygen, fire will not occur, but the mere presence of oxygen is not sufficient for fire to occur.

The following examples also illustrate this causal relationship

- To recover sea turtles, it is necessary to protect their nesting beaches (this statement means that if we do not protect their nesting beaches we will not recover sea turtles, but protecting nesting beaches is not enough to recover sea turtles)
- To recover spotted owls, it is necessary to protect late successional reserves

3. C is not a Necessary Condition but C is a Sufficient Condition for E

In this instance, when C is present, E is always present. However, other causal agents might also produce the effect (which is the same as saying "other causal agents might also be sufficient to produce the effect"). This describes one of the most common causal relationships in ecology and

biology. For example, harvesting adult animals in excess of recruitment rates is sufficient to cause a population to decline, but is not a necessary condition for population decline: we can cause a populations to decline without over-harvesting adults (for example, we can introduce diseases that kill all juveniles or we could over-harvest eggs and cause the same population to decline).

The following examples also illustrate this causal relationship

- Preventing the death of two, adult female northern right whales per year is sufficient to prevent the species from further declines
- Killing two adult, female Malaysian leatherback turtles is sufficient to increase the population's risk of extinction
- Killing four sub-adult, female Malaysian leatherback turtles is sufficient to increase the population's extinction risk

4. C is neither a Necessary Condition nor a Sufficient Condition for E

This relationship describes correlation rather than causation: C may or may not be present when E is present so we cannot assume that C caused E. Under these conditions, if a putative causal agent is present with an effect, some additional causal factor must also be present for the effect to have occurred. It is important to note that a putative causal agent may be neither necessary nor sufficient for an effect, but it may be a necessary for an effect because it is a catalyst or acts through interactions. This situation is important in most practical applications, particular in ecological applications (the reasons for this statement should become apparent in the next section).

6.2 Causal Scenarios

Thus far, this discussion has focused on relationships between a single causal agent ("necessary condition," "sufficient condition," or both) and a single effect or consequence. A reader would be justified in challenging this material because it has limited practical application because most causal situations involve more than one causal agent and several possible outcomes. We call these situations "causal scenarios" and we will demonstrate how to apply the concept of "necessary conditions" and "sufficient conditions" to these scenarios.

For example, consider the following situation. After investigating a fire at a store that was being remodeled, a fire inspector concludes that a short circuit caused the fire. Upon hearing this announcement, the electrical contractor asserts that the store would not have caught fire if the painting contractor had not left flammable material near the short circuit. Upon hearing this, the painting contractor asserts that the stores would not have caught fire if the owner had not disabled the sprinkler system before letting the contracts. What caused the fire?

When the inspector said "a short circuit caused the fire" it is clear that the short circuit was neither necessary nor sufficient for the fire (the short circuit was not necessary for the fire because a lit cigarette could have provided a spark; the short circuit was not sufficient for the fire because a fire might not have occurred without the presence of oxygen and flammable material). Rather, the inspector's statement means that the short circuit was a necessary component of a particular set of conditions (flammable material near the short circuit, no sprinkler system, etc.) that were sufficient for the fire.

So the statement "a short circuit caused the house fire" is more properly read to mean "the presence of a short circuit next to flammable material with no fire sprinkler made the fire is almost certain." Using the terms we have introduced previously, we would say the short circuit was a necessary part of a complex scenario that was itself unnecessary but was sufficient for the fire. We recommend studying this statement carefully because it describes the most common causal situation we encounter in consultations and most other environmental problems.

Stearns and Stearns[5] provide an ecological example of this kind of causal scenario in their description of the Laysan honeycreeper (*Himateone sanguinea freethi*). In the early 1900s, an entrepreneur introduced rabbits to Laysan Island that destroyed the vegetation on the island. Without vegetation, the honeycreeper's nests suffered in the face of egg predators like Bristle-thighed curlews and turnstones. In 1923, a biological survey concluded that the honeycreeper population had declined to about 3 birds. Shortly after the survey, the last 3 honeycreepers disappeared during a sandstorm and the subspecies became extinct.

What caused the honeycreeper's extinction? The entrepreneur, the rabbits, the predatory birds, or the sandstorm? By themselves, each of these potential causal agents was neither *necessary* nor *sufficient* to cause the honeycreeper's extinction; but they acted together to create a scenario in which the extinction was virtually guaranteed (if the sandstorm had not occurred, the birds were prone to extinction from inbreeding depression or demographic accident).

When we describe these kinds of scenarios, it is important to recognize that they usually consist of phenomena or conditions that must be present combined with phenomena or conditions that must be absent at the same time. In the example of the store fire, the spark and flammable material had to be present, but the sprinkler system had to be absent in order to produce the fire. In the example of the honeycreeper, the rabbits, the loss of cover and nest sites, the predatory birds, and the sandstorm had to be present, but the *absence* of immigration or suitable habitat on a nearby island were also factors in the species' extinction.

The principle applies to most other ecological situations. When the Services and Action Agencies argue that habitat modification "caused" a population to collapse or become extinct, the scenario we create will include conditions that must be present (the availability of food becomes limiting, loss of cover makes the species vulnerable to predators, competitors, parasites, or harmful temperatures, etc.) combined with conditions that must be absent (the availability of suitable, alternative sites with food resources, cover, etc.) for our statement to be true.

When the Services conclude that an Action "is likely to jeopardize a threatened or endangered species," we make the same assertion as the fire inspector. We rarely mean that the Action is necessary and sufficient for the jeopardy conclusion (although some actions are sufficient to produce that result). We usually mean that the direct and indirect effects of an Action, when conjoined with a species' status, environmental baseline, cumulative effects, and background conditions (like the laws of physics, bioenergetics, principles of population dynamics, etc.) form a scenario that is reasonably expected to appreciably reduce the species' likelihood of surviving and recovering in the wild.

5 S.C. Stearns and Stearns, B.P. 1999. Watching from the edge of extinction. Yale University Press; New Haven, Connecticut.

Actions, then, are often necessary parts of complex scenarios that include the direct and indirect Effects of the Action and: a listed resource's status (given the consequences of prior natural and anthropogenic phenomena across the resource's range); the environmental baseline (given the consequences of prior, contemporaneous, future natural, and future anthropogenic phenomena in an Action Area that are not State, local, or private); cumulative effects to form complex scenario sufficient to produce an outcome. Our argument becomes stronger when we can establish that other scenarios that might also be sufficient to produce the outcome, which do not include the Action, are not likely to occur in the Action Area.

6.3 Standard Form of Causal Arguments

The standard form for causal arguments, like the causal arguments themselves, has two primary differences from the standard form for non-causal arguments. The first difference appears in the major premises of these causal arguments which have three basic components: a causal agent (denoted C), an effect or consequence (denoted E), and a population, set of conditions, or circumstances in which the causal relationship applies (denoted P). The major premises of causal arguments will generally assume the form

C causes E in population P

The last element of these premises — the population or set of conditions or circumstances in which a causal relationship holds —provides critical context for causal arguments. Causal arguments that do not identify (explicitly or implicitly) a relevant population are easy to challenge because a factor that is causal in one population may not be causal in another. For example,

Demographic stochasticity *causes* increased extinction risk in small populations but

Demographic stochasticity *does not cause* increased extinction risk in large populations

Stress responses cause pathologies in some individuals, but not others. Human disturbance causes some animals to abandon a site under some circumstances, but not others. Small population sizes cause inbreeding depression in some species, but not others. Habitat alteration causes population declines under some circumstances, but not others. In ecology, biology, and physiology, many phenomena are limited to specific circumstances or conditions; good, causal arguments will specify those limits.

The second difference between causal and non-causal arguments appears in the structure of the arguments themselves. So far, we have established that there are several possible relationships between a putative cause and an effect. If we know that two factors, A and B, are positively correlated in population P, then only four causal connections can exist between A and B:

1. A causes B in P
2. B causes A in P
3. Some third factor independently causes A and B in P. That is, some third factor, C, causes A and also causes B, but there is no direct causal relationship between A and B
4. There is no causal connection between A and B in P (the correlation is accidental).

More than one of these alternatives may be true at a particular time, in a particular population, or under particular circumstances, so they are not exclusive. Since there are only four possible alter-

native explanations, a good causal argument will eliminate (rebut) the different causal possibilities to establish the sufficiency (or lack thereof) of a particular causal conclusion (alternatives 1 and 2 might both be true — two phenomena are mutually causal — and may be treated as a fifth alternative). With this knowledge, we can construct the following standard form for causal arguments

1. C is positively correlated with E in P
2. If C is positively correlated with E in P, then either the causal factors are reversed in this correlation (E causes C in P), or the correlation is the result of a common cause (a third factor causes both C and E and C and E have no direct causal relationship), or the correlation is accidental (C and E are causally independent), or C causes E in P
3. The causal factors are not reversed
4. The correlation is not the result of a common cause
5. The correlation is not accidental **So**: C
6. causes E in P.

We return to Example 4 (Page 14) to illustrate the applicant of these principles to an argument in consultation. That example consisted of the following conclusion from the technical assistance letter, with :

> Streambank and riparian damage caused by grazing livestock has affected and continues to impact Lahontan cutthroat trout. For example, a recent survey found many stream reaches had raw, actively eroding cutbanks and little riparian vegetation. Excessive grazing within the riparian area can lead to increased sedimentation, which causes mortality of embryos and fry through suffocation in the substrate. The proposed action will allow grazing in riparian areas within the range of the Lahontan cutthroat trout. Therefore, continued grazing is likely to adversely affect Lahontan cutthroat trout through mortality of embryos and fry.

When we reconstructed this paragraph, we divided it into two separate arguments. The first argument, which is contained in the first three sentences, was offered to establish a causal relationship between livestock grazing, erosion, damage to riparian vegetation, increased sedimentation, and harm to Lahontan cutthroat trout. The argument contained in the last three sentences appeared to have been offered to establish a causal relationship between the proposed action and the probable responses of the trout in the future. We reconstructed the first argument as

1. A recent survey found many stream reaches had raw, actively eroding cutbanks and little riparian vegetation
2. (since actively eroding cutbanks and little riparian vegetation is evidence of streambank and riparian damage caused by livestock)
3. (and since eroding cutbanks and little riparian vegetation is evidence of increased sedimentation in streams that impacts Lahontan cutthroat trout)
4. **So**: Streambank and riparian damage caused by grazing livestock has affected and continues to impact Lahontan cutthroat trout

Although we did not evaluate this part of the overall argument earlier, we evaluate it now in light of the material we have just presented on causal argument. The premises in this argument have the three elements of causal premises — cause, effect, and population. That is, "livestock (C) cause erosion (E) in streambanks (P)" so they have the proper structure of premises in causal arguments.

Although the premises have the correct structure, the argument does not. Livestock grazing is not a necessary condition for actively eroding cutbanks or little riparian vegetation, so other phenomena might have caused these conditions in the survey area. Therefore, eroding cutbanks and little riparian vegetation might be evidence of damage caused by livestock. but they are also evidence of causal agents unrelated to livestock. The argument establishes a potential correlation between livestock grazing, eroding cutbanks, and little riparian vegetation, but it is not sufficient to establish a causal relationship between these phenomena. If we reconstructed this statement in the standard form for causal arguments, the result would appear as

1. Livestock grazing (C) is positively correlated with erosion (E) in streambanks (P)
2. If C is positively correlated with E in P, then either the causal factors are reversed in this correlation (E causes C in P), or the correlation is the result of a common cause (a third factor causes both C and E and C and E have no direct causal relationship), or the correlation is accidental (C and E are causally independent), or C causes E in P
3. The causal factors are not reversed
4. The correlation is not the result of a common cause
5. The correlation is not accidental **So**: C
6. causes E in P.

In this situation, we do not need to demonstrate that the potential causal factors are reversed or that they are products of a common cause (it would be illogical to suggest that streamback erosion causes livestock grazing or that livestock grazing and streamback erosion have a common cause); so Premises 3 and 4 are irrelevant to the argument in this circumstance. That leaves Premise 5: we must argue that the relationship is not accidental or mere coincidence. Unless we supplement this argument to establish that the correlation between livestock grazing, eroding cutbanks, and little riparian vegetation is not accidental — that they are not caused by something unrelated to livestock grazing — the argument does not provide sufficient grounds for its conclusion.

This points to an important difference between causal and non-causal arguments: for causal argument to meet the sufficiency criterion of good argument, they must rebut counter-arguments based on Premises 3, 4, and 5 of the standard form of causal arguments.

7.0 Extended Arguments

Many of the arguments the Services and Action Agencies must develop and critically evaluate are properly called "extended arguments." An extended argument for a conclusion is one that contains one or more sub-arguments which provide reasons and evidence for conclusions (called "interme- diate conclusions") that are then used as premises in subsequent arguments. The assessment framework that forms the foundation for the Advanced Section 7 Training (see Figure 1) repre- sents an extended argument. Exposure analyses are designed to form an argument that allows us to reach rational conclusions about the individuals that would co-occur in space and time with the stressors or subsidies produced by an action, the populations those individuals represent, the dura-

tion of their exposure, etc. Response analyses begin with the conclusions of our exposure sub-arguments and extend them so we can make inferences about the probable responses of the individuals that have been exposed. Risk analyses then take the conclusions of our response analyses and extend them so we can make inferences about the probable consequences of exposure for the fitness of the individuals that have been exposed, the viability of the populations those individuals represent, and the viability of the species those populations comprise.

The arguments that must support our jeopardy or destruction or adverse modification conclusions are extended arguments. The variables the Services are required to consider — the status of the listed resources, the environmental baseline of an action area, the effects of an action, and cumulative effects — are part of those extended arguments. The rules of good arguments apply to extended arguments as well as any other form of argument, reconstructing them just requires more time and care to insure that the entire argument, as well as each step of it, satisfy the criteria of good arguments. The narratives that follow present and discuss extended arguments that should support jeopardy and destruction or adverse modification conclusions on biological opinions.

7.1 Jeopardy Arguments as Extended Arguments

Section 7 of the Endangered Species Act of 1973, as amended, requires federal agencies, in consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service, to insure that their actions are not likely to jeopardize the continued existence of threatened or endangered species. In regulation, the Services defined "jeopardize the continued existence of" as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (we will not address the proper interpretation of the jeopardy standard in this Study Guide; the issue is addressed in the Risk Analysis Study Guide). By regulation, the Services are also required to consider a listed species' status, the environmental baseline of an action area, the effects of an action (as defined in regulation), and cumulative effects when deciding whether an action is or is not likely to jeopardize listed species.

Jeopardy determinations are one of the most important conclusions of any consultation. As discussed in the introduction to this study guide, to insure compliance with the APA, the Services must insure our jeopardy determinations are not arbitrary or capricious. We achieve this outcome by insuring that (a) we did not rely on factors which Congress did not intend us to consider, (b) we did not fail to consider an important aspect of a problem, (c) we offer an explanation for our conclusion that does not run counter to the evidence before us, and (d) we did not fail to articulate a rational connection between our facts and our "jeopardy" or "no jeopardy" conclusion.

Our best strategy for insuring compliance with these requirements it to treat each jeopardy or no jeopardy determination as an argument that must satisfy the criteria of good arguments that we have discussed thus far. When we develop and present those arguments, we can use one of three approaches:

- we can argue to a "jeopardy" conclusion,
- we can argue to a "no jeopardy" conclusion, or
- we can argue to both conclusions and accept the argument that has strongest support in the available evidence.

Box 3. An extended argument for a "jeopardy" or "no jeopardy" conclusion presented in standard form

1. The proposed action's effects are distributed over a particular area at particular times [a conclusion supported by (biological assessment, informal consultation or other document)]
2. and listed species are likely to be exposed to those effects at particular levels, in a particular area, at particular times [a conclusion supported by (name supporting document)]
3. and the listed species has (background extinction risk or persistence probability) [a conclusion supported by "Status" sub-argument]
4. and the populations in the Action Area have (status, trend, demographic condition, and background extinction risk) [a conclusion supported by "Environmental Baseline" sub-argument]
5. and the individuals in the Action Area have (antecedent physical, physiological, and behavioral condition) [a conclusion supported by "Environmental Baseline" sub-argument]
6. and the individuals in the Action Area are also expected to be experience changes in fitness in response to the effects of the action [a conclusion supported by "Effects of the Action" sub-argument]
7. and the populations in the Action Area are also expected to be experience changes in viability in response to cumulative effects [a conclusion supported by "Cumulative Effects" sub-argument]
8. and those changes in population viability (are/are not) sufficient to appreciably increase the extinction risk (or reduce the likelihood of conserving) the species those populations comprise [a conclusion supported by risk portion of the "Effects of the Action" sub-argument]
9. and since (general inferences we make from this set of circumstances using principles of the biology and ecology of populations, particularly that of small or declining populations; our prior experience; etc.)
10. and (rebuttal to arguments supporting alternative conclusion)

11. **So:** the Service concludes that the Action (is/is not likely) to jeopardize the continued existence of the listed species by reducing the reproduction, numbers, or distribution of that species

Historically, the Services seem to have taken one of the first two approaches to developing arguments in biological opinions. Arguments to "jeopardy" conclusions seem to accept that the purpose of biological opinions is to demonstrate that federal action are not likely to jeopardize the continued existence of those species. Arguments to "no jeopardy" conclusions seem to accept that the purpose of biological opinions is to demonstrate that federal action are not likely to jeopardize the continued existence of those species.

Both of these approaches to presenting arguments to support "jeopardy" or "no jeopardy" determinations do not rebut arguments that might support the alternative conclusion (that is, "jeopardy" arguments might not evaluate the reasons and evidence to determine if they might support "no jeopardy" conclusions; "no jeopardy" arguments might not evaluate the reasons and evidence to determine if they might support "jeopardy" conclusions). Arguments to both conclusions make neither assumption and rely on the strength of the evidence to decide which conclusion has the most rational support in the available evidence.

The latter approach is called a "strength of the evidence" approach to decision-making. The four criteria of good arguments introduced in this Study Guide are designed to produce conclusions that have the strongest support in the evidence if, and only if, arguers satisfy the rebuttal criterion.

Box 4. An extended argument for a "destruction or adverse modification" or "no destruction or adverse modification" conclusion presented in standard form

1. The proposed action's effects are distributed over a particular area at particular times [a conclusion supported by (biological assessment, informal consultation or other document)]
2. and designated critical habitat is likely to be exposed to those effects at particular levels, in a particular area, at particular times [a conclusion supported by (name supporting document)]
3. and the designated critical habitat has (background conservation value) [a conclusion supported by "Status" sub-argument]
4. and the sites of the designated area in the Action Area have (conservation value based on the quality, quantity, or availability of constituent elements) [a conclusion supported by "Environmental Baseline" sub-argument]
5. and the constituent elements in the Action Area is also expected to be experience changes in quality, quantity, or availability in response to the effects of the action [a conclusion supported by "Effects of the Action" sub-argument]
6. and the sites of the designated area also expected to be experience changes in conservation value in response to cumulative effects [a conclusion supported by "Cumulative Effects" sub-argument]
7. and those changes in the conservation value (are/are not) sufficient to appreciably reduce the conservation value of the entire designated critical habitat [a conclusion supported by risk portion of the "Effects of the Action" sub-argument]
8. and since (general inferences we make from this set of circumstances using principles of the biology and ecology of populations, particularly that of small or declining populations; our prior experience; etc.)
9. and (rebuttal to arguments supporting alternative conclusion)

10. **So:** the Service concludes that the Action (is/is not likely) to result in the destruction or adverse modification of designated critical habitat by appreciably reducing it value for the conservation of listed species

7.2 Destruction or Adverse Modification Argument as Extended Arguments

Section 7 of the Endangered Species Act of 1973, as amended, also requires federal agencies, in consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service, to insure that their actions are not likely to result in the destruction or adverse modification of critical habitat designated for threatened or endangered species.

Destruction or adverse modification determinations are also the most important conclusion of any consultation. As discussed in the introduction to this study guide, to insure compliance with the APA, the Services must insure that these determinations are not arbitrary or capricious, which we achieve by insuring that (a) we did not rely on factors which Congress did not intend us to consider, (b) we did not fail to consider an important aspect of a problem, (c) we offer an explanation for our conclusion that does not run counter to the evidence before us, and (d) we did not fail to articulate a rational connection between our facts and our "destruction or adverse modification" conclusions.

Our best strategy for insuring compliance with these requirements it to treat each destruction or adverse modification determination as an argument that must satisfy the criteria of good arguments that we have discussed thus far. Like "jeopardy" arguments, when we develop and present argu-

ments to support our "destruction or adverse modification" determinations, we can use one of three approaches:

- we can argue to a "destruction or adverse modification" conclusion,
- we can argue to a "no destruction or adverse modification" conclusion, or
- we can argue to both conclusions and accept the argument that has strongest support in the available evidence.

It is important to note the differences between the two arguments contained in Boxes 3 and 4. The arguments that support "jeopardy" determinations must address consequences for listed individu- als, the populations those individuals represent, and the listed species those populations comprise (Premises 6, 7, and 8 of Box 3). Even "habitat-based" jeopardy arguments must ultimately demonstrate that listed individuals, the populations those individuals represent, and the species those population comprise are or are not likely to experience reductions in their likelihood of both surviving and recovering in the wild. Compare this to the premises of the arguments that support "destruction or adverse modification" determinations, which address the quality, quantity, and availability of constituent elements, sites, and a critical habitat designation. Note that this argument can safely ignore those considerations and meet the sufficiency criterion of good arguments.

8.0 Resolving Arguments

There is a legal limit on the duration of section 7 consultations. This limits the amount of time that is available to the Services and Action Agencies to gather and critically evaluate evidence and reach conclusions based on that evidence. As a result, it will often be important to know when the matters in a consultation can be considered resolved and consultation concluded.

Based on principles articulated by Damer (2001) and Feldman (1999) we should consider a consultation resolved if the reasons and evidence supporting the three different outcomes that must be decided in consultations — "likely to adversely affect" or "not likely to adversely affect"; "jeop- ardy" or "no jeopardy"; "destruction or adverse modification" or not — can be successfully de- fended by an argument that uses relevant and acceptable premises that together provide sufficient grounds to support the conclusion and provides an effective and stronger rebuttal to the alterna- tive. Unless an Action Agency, Applicant, or other participant in a consultation demonstrates that these conditions have not been met, the Services will have reached a legally-defensible conclusion to a consultation.

Even when the Services apply these principles to a consultation, some degree of uncertainty about the truth or falsity of our conclusion will remain. That situation is not unique to consultation; it is common to any situation that requires anyone to make inferences about future conditions based on an incomplete knowledge of the future. Remember the fallibility principle, which requires us to accept that we may be wrong about our ideas, conclusions, or propositions, regardless of the care we put into developing them. Nevertheless, by applying the principles described in this Study Guide we can produce conclusions that are rational to accept as true given the evidence available.

Literature Cited and Further Reading

This study guide integrates ideas, principles, practices, and materials from a large number of sources, many of them are contained in the following list of references. In particular, Bowell and Kemp (2002), Damer (2001), and Feldman (1999) provided the criteria of good arguments and rules of conduct for argument-based inquiries form the foundation of the material contained in this study guide. Damer (2001) and Feldman (1999) were the source of the material on causal arguments while Einhorn and Hogarth (1986) were the source of the material on causal scenarios. The sources that were particularly important to developing this study guide are highlighted in bold.

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Exercises

Exercise 1. Reconstruct the argument contained in the following sections of your biological opinion:

1. The Status of the Resource. Select at least one listed resource from the Status of the Listed Resource section of your biological opinion.
   a. Does the biological opinion reach a conclusion about the status of the listed resource?
   b. What is the conclusion?
   c. What reasons or evidence (premises) support that conclusion?
   d. Reconstruct the argument in standard form. Is the argument that supports the conclusion a "good" argument?

5. The Environmental Baseline
   a. Does the biological opinion reach a conclusion about the impact of the environmental baseline on listed resources?
   b. What is the conclusion?
   c. What reasons or evidence (premises) support that conclusion?
   d. Reconstruct the argument in standard form. Is the argument that supports the conclusion a "good" argument?

5. The Conclusion. Select at least one conclusion listed resource
   a. What conclusion does the biological opinion reach?
   b. What reasons or evidence (premises) support that conclusion?
   c. Reconstruct the argument in standard form and evaluate the it using the four criteria of a good argument: the premises are relevant, the premises are acceptable, the premises are sufficient, and the argument rebuts counter arguments.
   d. Given the evidence contained in the paragraph, would it be more reasonable to expect the conclusion to be true than it would be expect the conclusion to be false?
   e. Explain your answer to Question 6.

Exercise 2. Reconstruct the following paragraph in standard form and evaluate the result

It has long been recognized that the Indiana bat requires winter sites that are disturbance free and do not experience freezing temperatures, particularly because of the species' vulnerability when large numbers of individuals are gathered in discrete areas of the hibernacula. Protection of only one life stage (hibernacula) is not adequate to ensure the survival and recovery of this species since the threat of disturbance and vandalism has apparently been abated, yet the range-wide population trend continues to decrease. All other life stages (i.e. migration, fall swarming, raising of young), particularly the birthing and raising of young requires a high level of protection too. The destruction of forest habitat could have a serious impact Indiana bat populations (U.S. Fish and Wildlife Service 1983). Therefore, adequate summer maternity habitat (roosts with appropriate microclimatic conditions for raising young, adequate foraging area, etc.) is crucial to ensure critical recruitment. Because of the colonial nature of the species and the ability for a female Indiana bat to only give birth to one pup annually, protection of maternity colonies is essential for the survival and recovery of this species. A maternity colony, or nursery area, refers to the area where pregnant female bats congregate to give birth and care for their young (Hill and Smith 1986).

1. Does this paragraph reach a conclusion?
2. What is the conclusion?
3. Does this paragraph provide reasons or evidence to support that conclusion?
4. What reasons or evidence (premises) does the paragraph offer to support its conclusion?
5. Reconstruct the argument in standard form and evaluate the it using the four criteria of a good argument: the premises are relevant, the premises are acceptable, the premises are sufficient, and the argument rebuts counter arguments.
6. Given the evidence contained in the paragraph, would it be more reasonable to expect the conclusion to be true than it would be expect the conclusion to be false?
7. Explain your answer to Question 6.

Exercise 3. Reconstruct the following paragraph in standard form and evaluate the result

The most likely proximate hypothesis for the demise of the Squirrel Valley population is starvation. That is, the blatant disturbance to a key portion of the animals' food resource base (seeds of native plants) made it impossible for many individuals (especially young and old females) to reproduce effectively and then store enough fat to survive 7-8 months in hibernation. Over the longer term, it is possible that the population was caught in an evolutionary trap. In congeneric ground squirrels, condition of the native vegetation at spring emergence is a reliable cue of whether there will be sufficient forage to support reproduction and prehibernatory fattening. The *S. b. brunneus* at Squirrel Valley did not receive an early-season cue that their food base would be nutritionally inadequate (lacking in seeds) and, in many years, unavailable (dried up or eaten by livestock) later in the active season. Thus, they did not respond adaptively to impending food-plant failure by reducing litter sizes or curtailing reproduction in order to fatten early. The consequence may have been increased overwinter mortality, especially for the youngest and oldest females, i.e., those that bore the greatest physiological burdens of gestation and lactation.

1. Does this paragraph reach a conclusion?
2. What is the conclusion?
3. Does this paragraph provide reasons or evidence to support that conclusion?
4. What reasons or evidence (premises) does the paragraph offer to support its conclusion?
5. Reconstruct the argument in standard form and evaluate the it using the four criteria of a good argument: the premises are relevant, the premises are acceptable, the premises are sufficient, and the argument rebuts counter arguments.
6. Given the evidence contained in the paragraph, would it be more reasonable to expect the conclusion to be true than it would be expect the conclusion to be false?
7. Explain your answer to Question 6.

Exercise 4. Reconstruct the following paragraph in standard form and evaluate the result

…variation in individual fitness of flycatchers probably translates to variation in responses to habitat loss/degradation and subsequent survivorship and reproductive success. Thus, not all flycatchers are likely to perish as a result of displacement [due to habitat loss] and not all flycatchers are likely to fail to attract mates and breed [after dispersal]. The more likely result would be a regional phenomenon of "loss-disperse-decrease" whereby: (1) large habitat patches occupied by the larger breeding groups are lost either by stochastic (e.g., fire) or deterministic processes (e.g., permitted Federal action); (2) surviving birds are forced to disperse elsewhere, most likely into smaller habitat patches; and (3) this dispersal causes decreases in the probabilities of survival, of obtaining mates, and of reproducing successfully. This hypothesis is based on the assumption that there is a negative relationship between habitat isolation and flycatcher survival and reproduction. This phenomenon could actually lead to a short-term increase in the number of sites occupied regionally while masking an overall, long- term decrease in population size and fecundity.

Dispersal due to habitat loss is not unique to Lake Mead, but has also been documented at Lake Isabella on the South Fork Kern River in California (Whitfield and Strong 1995), at Elephant Butte Reservoir on the Rio Grande in New Mexico (Hubbard 1987), and is anticipated to occur at the Roosevelt Lake breeding sites in Arizona (USFWS 1996). These areas represent some of the largest known riparian habitat patches in the Southwest. In some cases the habitat modifications (i.e., inundation) occurred during the breeding season. Thus, flycatchers were, in all likelihood, forced to disperse to smaller patches potentially incurring increased risk of predation, increased competition for suitable habitat elsewhere, and delayed or foregone breeding opportunities.

1.

2. 3. 4.

5.

6.

7.

Does this paragraph reach a conclusion?

What is the conclusion?

Does this paragraph provide reasons or evidence to support that conclusion?

What reasons or evidence (premises) does the paragraph offer to support its conclusion?

Reconstruct the argument in standard form and evaluate the it using the four criteria of a good argument: the premises are relevant, the premises are acceptable, the premises are sufficient, and the argument rebuts counter arguments.

Given the evidence contained in the paragraph, would it be more reasonable to expect the conclusion to be true than it would be expect the conclusion to be false?
Explain your answer to Question