# BUILDING EVIDENCE LIBRARIES

## Organizing, Assessing, and Presenting the Evidence Behind Your Hypotheses

Mac users see footnote*

**This document walks through an overview of a cross sector evidence library, the steps to build one, and then provides an example evidence library entry to illustrate the approach described. We recognize that evidence libraries can be applicable for a single sector project, but have included this tip-sheet in this cross sector guidance because we see the creation of these libraries as a way to synthesize cross-sector evidence in a way that makes it more accessible to multi-sector users. No one is an expert in all sectors, and these libraries represent one way to make cross-sector evidence more usable by those working across sectors.**

## What is an evidence library and why might you create one?

Evidence libraries are a collection of organized descriptions of the assemblage of evidence that supports or refutes assumed relationships between aspects of a system[1].

### Why create one?

To fully explain the evidence you have collected for a set of particular **hypotheses**, and to put this evidence in a brief, readable format for others who might want to reference it.

Evidence libraries are particularly helpful for organizing evidence collected to support the links (i.e. relationships) shown in a causal diagram such as a **results chain** or **situation analysis**.

## What is evidence?

### Evidence definition:

The available body of verifiable facts or verifiable, relevant information from any sector or discipline indicating that a hypothesis (or assumption) can be supported, considered valid, or

* This interactive PDF may not display or function properly in Mac Preview. Mac users are asked to view this worksheet in a PDF reader such as Adobe Acrobat Reader DC (free to download).

[1] This text is a modified excerpt from the Building Ecosystem Services Conceptual Models document

refuted. We take a broad and inclusive definition of evidence and accept information from the following sources, which we define for use in this context:

- **Expert knowledge:** The judgement of those with specialized knowledge obtained through training or experience. This includes local knowledge, traditional knowledge, and subject matter expertise.
- **Measurement results:** Information gained from any measurement which may or may not be part of a study.
- **Models:** A description or representation of an object or system. Models can be conceptual, mathematical, physical, mental or computational. Models can be used in conjunction with quantitative or qualitative studies, theory, or expert knowledge.
- **Qualitative studies:** Studies based on inference through a thorough understanding of a case(s) under study, but unable to characterize an absolute numerical relationship between parts of a system.
- **Quantitative studies**: Studies based on inference through numerical data and analysis that describe the relationship between parts of a system. Quantitative studies may be experimental, quasi-experimental or observational.
- **Theory:** A scientifically accepted general principle or body of principles offered to explain phenomena[2].

**A description of the evidence for a particular hypothesis is referred to as an evidence library *entry*. In the context of a conceptual diagram, an evidence library entry would be for a single relationship (link) in a situation analysis or results chain. The collection of entries for an entire results chain or situation analysis makes up the evidence *library*.** A broad use of evidence to create an evidence library is appropriate, especially in a cross-sector context, given the diversity of disciplines likely to be represented.

## How might an evidence library be used?

- To identify knowledge gaps about a system (i.e. identification of links of the results chain where we find little evidence)
- To determine what we know about the direction and magnitude of hypothesized relationships
- To provide best available science summaries, as a way to keep people in the future from starting research from scratch
- To determine/verify which outcomes are strongly linked to the intervention and which ones are not

[2] This text is a modified excerpt from the Bridge Practitioner's Guide

## What should go in each library entry?

Each library entry describes the evidence supporting a hypothesis. The hypothesis can be a stand-alone assumption that requires an evidence summary, or it can be a hypothesis that links two nodes in a results chain or situation analysis diagram (i.e. it describes the relationship between those two nodes).

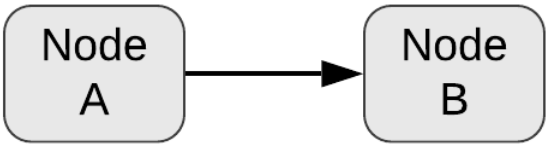


***Figure 1.*** Two nodes in a results chain or situation analysis diagram, connected by a link. The link represents a testable hypothesis that can be assessed based on evidence collection for an evidence library entry.

### Five main parts of each evidence library entry:

- **Description of the relationship** between two nodes. This starts as an assumption, but it can become an evidence-based description through development of the library and assessment of evidence.
- **Summary of the evidence** found relating to the assumption.
- **List of other factors** that may result in variation (location, timing, external drivers, and so on) in direction or magnitude of effect described in the assumption
- **Summary of confidence** in the assumption given available evidence (see evidence assessment rubric)
- **List of resources**[3]

## Time and effort required to build an evidence library

Building an evidence library requires significant effort. Putting together an entry for a single link can take anywhere from 1-6 hours, depending on your familiarity with the evidence and subject matter. To put together a library for a complex conceptual diagram can take a full-time employee three or more months. It is recommended that you only build a full evidence library when the final product will be extensively used by a community that would benefit from reference evidence summaries.

[3] This text is a modified excerpt from the Building Ecosystem Services Conceptual Models document

## Tips on building evidence libraries

Tip 1: An initial assessment of evidence does not require development of full systematic reviews for each relationship, but it could incorporate systematic reviews done by others. Over time and with resources, evidence libraries can be further developed and refined given users' needs.

Tip 2: The stakeholders and experts initially involved in model development can be a resource for gathering evidence. Additional experts can be brought in to fill in gaps and review evidence.

Tip 3: Two kinds of information can be included in evidence libraries: evidence and examples. Evidence describes general or site specific relationships between nodes and can include individual research studies, models, calculators, and meta-analysis results. Individual research studies can provide evidence for the existence of a relationship, but they are usually considered to be low-quality evidence for contexts other than the one in which the study was conducted.

For links with missing or weak evidence, examples can be provided of site-specific studies that could be done. In many cases, the example studies are individual research studies conducted in other contexts that are considered part of the body of evidence for the relationship but that also provide a useful example of how the relationship could be assessed in the focal context. The example studies can also be general methods papers that describe an approach but that do not contribute to evidence for the specific relationship of interest. Examples are an optional addition[4].

Tip 4: Collecting evidence for an evidence library can often change the way you think about a system. You can use the evidence library creation process to help you modify an existing results chain or situation analysis diagram to make it better reflect the available evidence. If you are collecting evidence to summarize what is known about a single hypothesis, building out an evidence library entry can help refine that hypothesis.

Tip 5: If you are building an evidence library for a results chain or situation analysis diagram, it is helpful to create ID numbers for each link in the chain that can be used to reference individual library entries. This helps increase ease of use of the evidence library, so that people can easily reference the diagram and accompanying evidence summaries.

Tip 6: Sometimes the way you phrase a question will determine the evidence you find for a particular library entry. Sometimes you need to alter your terminology to find the evidence you need. For example, a group was trying to examine the evidence for the results chain made up of the following links: sediment capture by marsh plants → suspended sediments in stream water → quality of drinking water. The group was having trouble finding evidence for the first link. It was only after searching for evidence using the term "accretion," rather than "sediment capture" that they were able to find relevant and useful evidence. Sometimes you need to reach out to an expert, even if it is within your own sector, to determine what key words might be to find the right evidence.

[4] The text in this section up to this point is a modified excerpt from the Building Ecosystem Services Conceptual Models document

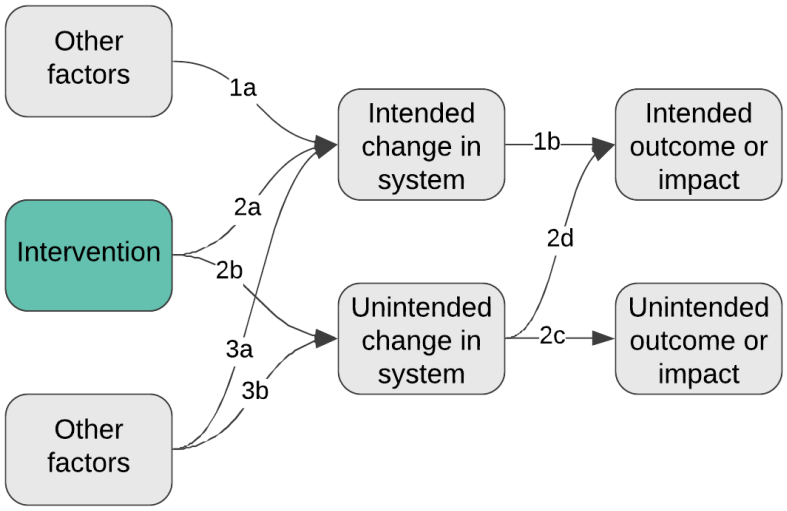


***Figure 2.*** Example results chain with link ID numbers added. The evidence library could be organized by link ID number.

## Example evidence library entry

Here we provide an example evidence library entry for reference. The evidence library entry below is for link 1e in the example results chain shown in Figure 3. This results chain illustrates how reduced fertilizer use on farms might result in changes to commercial fishing practices. Link 1e, the final link in this chain, represents the hypothesized relationship between the concentration of harmful algal bloom toxins and commercial fishing practices. The evidence library entry includes the five sections outlined above.

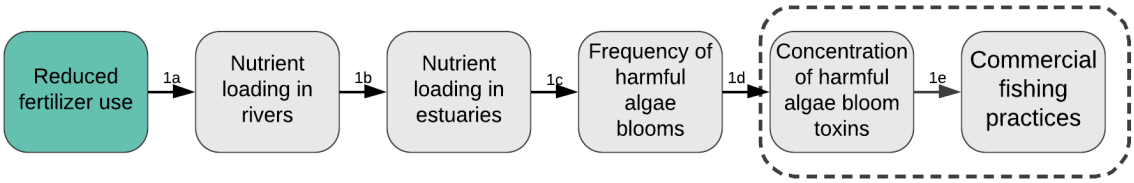


***Figure 3.*** Example results chain with link ID numbers. The dotted line surrounds the nodes connected by the link described in the evidence library entry below.

### 1e: Harmful algal bloom toxins → commercial fishing

**Description of Relationship**

Harmful algal bloom (HAB) toxins can contaminate fish and shellfish. These toxins can cause harmful symptoms and even death for humans when ingested, so when these toxins are detected in seafood or water, commercial fisheries are often shut down.

**Summary of Evidence**

The National Science and Technology Council Subcommittee on Ocean Science and Technology released a report on harmful algae blooms. Appendices 1 and 2 of the report provide a summary of the toxins produced during different kinds of blooms, and those that impact commercial fishing are provided in Table 1.

**Table 1. Harmful Algal Taxa and Effects on Fisheries**

| HAB taxa | Toxin/bioactive compound | Fishery closure reason | Impacted areas in the United States |
|---|---|---|---|
| *Pseudo-nitzschia* | Domoic acid | Amnesic shellfish poisoning → Shellfish harvesting closure | West Coast, Florida, Maine |
| *Dinophysis; Prorocentrum* | Okadaic acid, dinophysotoxins | Diarrhetic shellfish poisoning → Shellfish fishery closure | Oregon, Texas, Washington |
| *Gambierdiscus; Fukuyoa* | Ciguatoxins | Ciguatera fish poisoning → Bans on fish sales from affected areas | Florida, Gulf Coast, Hawaii, Pacific, Caribbean |
| *Karenia* | Brevetoxins | Neurotoxic shellfish poisoning → Shellfish fishery closure | Gulf of Mexico, Atlantic coast up to North Carolina |
| *Alexandrium; Gymnodinium; Pyrodinium bahamense* | Saxitoxins | Paralytic shellfish poisoning → Shellfish fishery closure | Pacific coast (incl. Alaska), northeast Atlantic coast, Florida |
| *Prorocentrum minimum—Mahogany Tides* | Not characterized | Mortality of spat in shellfish hatcheries → Lost shellfish | Chesapeake Bay |

***Source: National Science and Technology Council (2016).***

A review of studies that examined commercial fishery effects resulting from harmful algae blooms from 1987 to 1992 showed annual costs across the United States ranging from $7 million to $19 million (measured in 2000 USD) (Hoagland et al. 2002, see Table 3). The effects measure impacts such as harvest losses, reduced sales, and farmed fish kills.

### Other Factors

Depending on the HAB type and severity, fishery closure lengths may differ. The length of a closure will in part determine the severity of the impact on a fishery.

### Strength of Evidence[5]

**Fair.** Toxin detection will almost always result in temporary closure of relevant commercial fisheries. The specific impacts of closures will depend on HAB type, length, and extent; however, the impact on fisheries is reasonably certain. Estimating specific outcomes will be determined by the site and the species that are commercially harvested. Site-specific information on the toxin type and the local fish species will be essential for predicting the commercial fishing impacts of algal toxins. Site-specific studies and local data are needed to make accurate estimates of how HAB toxins will affect a local fishery. A review of such studies can be found in Hoagland et al. (2002); these studies examine outcomes such as temporary or permanent fishery closures, harvest losses, reduced sales, fish kills, and seafood recalls.

[5] See Evidence Rubric Tipsheet for a description of how to score strength of evidence

**Sources**

Hoagland, P., D.M. Anderson, Y. Kaoru, and A.W. White. 2002. "The Economic Effects of Harmful Algal Blooms in the United States: Estimates, Assessment Issues, and Information Needs." Estuaries and Coasts 25 (4): 819–837.

National Science and Technology Council. 2016. "Harmful Algal Blooms and Hypoxia: Comprehensive Research Plan and Action Strategy." https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/NSTC/final_habs_hypoxia_research_plan_and_action.pdf

## Additional resources

### Evidence library examples

To see examples of completed evidence libraries using the approach outlined in this document, see Mason et al. (2018) and Warnell et al. (2018).

The International Rescue Committee's interactive Outcomes and Evidence Framework is an online, interactive evidence library delivers key information on outcomes related to health, safety, education, economic wellbeing, and power through theories of change (another term for results chains), provides evidence for interventions that work or don't work to achieve the outcomes, and includes guidance on how to measure progress (IRC, 2019).