

Applying Systematic Evidence Reviews in Ecology: Challenges and Opportunities

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Outline

- Background in Clinical Medicine
- Basic Concepts
- Applicability to Environmental Practices
- Role in Program/Practice Evaluation

Background in Medicine

- Originated in UK in 1980's. Medical practices varied geographically. No up to date consensus on “best practices”
- Crux of problem - poor transfer of the huge volume of medical *science* to medical *practice*.
- 1993: Cochrane Collaboration
- SERs published on Cochrane Online Database:
 - 1995- 36 SERs
 - Today- 2000+ SERs. 100's more each year.

Basic Concepts: How Do SERs Work?

“Turbocharged literature review.”

Key characteristics:

- *Specific targeted question*, e.g. “In middle-aged white males (population), does Lipitor (treatment) reduce cholesterol (outcome), compared to no treatment?” (comparator)
- Targeted questions clarify purpose of review and help reviewer to decide which studies are relevant and which are not.
- SERs use an explicit *protocol*, developed prior to the review, that specifies exactly how it will be conducted.

Elements of SER Protocols

- Background: Context for question, why it is important
- Objective: Review question or questions
- Methods:
 - Search strategy (journals, databases, keywords)
 - Study inclusion criteria
 - Study quality assessment criteria
 - Data extraction strategy
 - Data synthesis (meta-analysis when appropriate)
- Funding sources and potential conflicts of interest

SERs: *Exhaustive, Transparent, Rigorous*

- Goal: identify all relevant research, including unpublished or “gray” literature
- Document all steps of the review.
- Research “quality” is explicitly assessed, usually based on study design- perhaps the most notable aspect of SERs
- SER results are used to develop *clinical practice guidelines* for everyday medical practice decisions

Assessing Evidence Quality

- How reliable is each particular piece of evidence? How strong is the overall *body* of evidence?
- How well does each study's design, conduct, and analysis minimize selection, measurement, and confounding biases
- Randomized controlled clinical trials are strongly favored
- How can different types of evidence be included?

Evidence Quality Hierarchy

1. **Experimental study**
 - a. **Randomized controlled trial**
 - b. **Experimental study without randomization**

2. **Observational study *with* control group**
 - a. **Cohort study**
 - b. **Case-controlled study**

3. **Observational study *without* control group**
 - a. **Cross-sectional study**
 - b. **Before and after study**
 - c. **Case series**

4. **Case reports**

Evidence Quality Hierarchy

- I-1. Meta-analysis of multiple well-designed, randomized, controlled clinical trials
- I-2. Well-controlled, randomized clinical trials with adequate sample size
- I-3. Well-designed trial without randomization (single group pre/post, cohort, time series studies)
- II-1. Well-conducted, systematic review of non-experimental design studies
- II-2. Well-conducted case-control studies
- II-3. Poorly controlled (flawed randomized studies) or uncontrolled studies (correlational descriptive studies)
- II-4. Conflicting evidence or meta-analysis showing a trend that did not reach significance.
- III-1. Qualitative designs: case studies, opinions of expert authorities, agencies or committees

Synthesizing Evidence

- Narrative synthesis
- Original data is extracted and meta-analysis performed whenever possible
- Criteria for assessing the body of evidence:
 - quality*: aggregate of quality ratings
 - quantity*: number of studies, sample sizes, etc
 - consistency* of results
 - coherence*: do findings make sense as a whole?

Challenges to Applying SERs to Environmental Practice

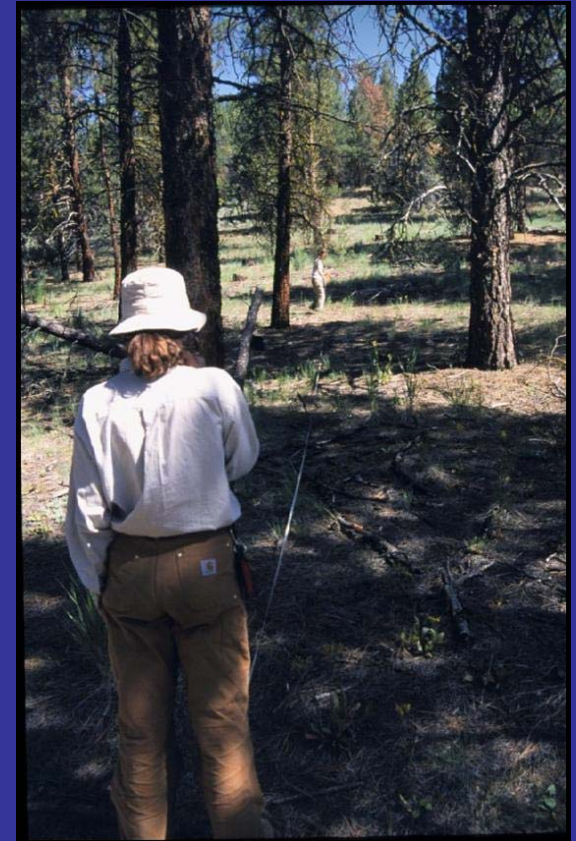
- Goal of medicine- improve human health- not controversial.
- Natural resource management- usually multiple goals- often controversial

Challenges in Applying SERs to Environmental Practice

- Species and Scale
- Harder to parse out targeted (reductionistic) questions
- Relevant evidence more situation specific

Challenges to Applying SERs to Environmental Practices

- Evidence base in ecosystem science is much less extensive but also more methodologically diverse, fewer laboratory controls.



Challenges to Applying SERs to Environmental Practice

- *Extrapolation* beyond study location is more problematic in ecosystem science.



Environmental Practice SER Challenges in a Nutshell

- Deciding which studies or pieces of evidence are “in” the review and which are “out” ...
- For many questions, much of the available evidence may be *tangentially related* falling somewhere between direct relevance and complete irrelevance.
- Assessing and ranking evidence “quality.”

Opportunities

- Using SER process for questions involving a *single species or single management action*
- Questions specific enough to allow inclusion of enough evidence to make the review worthwhile, but also limit it to a manageable scope.
- Some SER *procedures* could be more readily adopted than full SERs

Option 1: *Incorporate SER procedures into “in-house” science assessments and any external review of this work*

- Example question: In watersheds with **salmonids** (subject) do **buffer strips** on non-fishbearing streams (intervention) result in **lower water temperatures** in fishbearing streams (outcome) compared to **no buffer strips** (comparator)?
- Develop a **protocol** and carefully **document** details about how the review is conducted:
 - literature search strategy: search terms, databases, journals
 - criteria for deciding which studies and papers to include
 - some degree of quality assessment

Relative quality level	Study design	Example Observation	Relative Level of confidence
1.	Replicated sampling, replicated controls, sampling before and after rehabilitation	‘The increase in the number of salmon in the treated reach was greater than any increase at either control reach’	Very high
2.	Unreplicated, controlled, sampling before and after rehabilitation	‘The number of salmon increased after rehabilitation in the treated reach, but not in the control reach’	High
3.	Unreplicated, uncontrolled, sampling before and after rehabilitation; OR Unreplicated, controlled, sampling after rehabilitation	‘There were more salmon after the work than before’; OR ‘After rehabilitation there were more salmon in the control reach than in the treated reach’	Moderate
4.	Unreplicated, uncontrolled, sampling after rehabilitation	‘There was a gradual increase in the number of salmon in the two years after the work’	Low
5.	Unreplicated, uncontrolled, anecdotal observation after rehabilitation	‘I saw lots of salmon after we had done the work’	Very low

Option 2: Commission an SER by an external, independent academic entity

- Might be triggered by a politically sensitive or difficult scientific question
- Intent would be to develop a defensible SER, with every effort made to identify and include all relevant evidence
- Agency develop question(s), vet with stakeholders and refine with external review team
- Review protocol: collaborative effort with agency and review team

Option 3: *Participate in an Interagency SER*

- Address regionally significant, highly policy relevant questions using the SER process. Many potential variants:
- Bring together technical specialists from multiple agencies (ODF, USFS, BLM, EPA, USFWS, NOAA) to develop questions, a protocol and conduct the review *OR...*
- Commission review through an academic entity as described in Option 2, but solicit and coordinate support from other state and federal agencies

Post Wildfire Management Activities: Salvage Logging, Restoration



Caveats and Cautions

- SERs involve judgment calls at several levels: which studies to include, how to assess and rank them for quality
- SERs do not solve the “burden of proof” issue, or questions about how much evidence is necessary
- SERs are designed to synthesize science, not make policy, but this is not rigid boundary
- “Absence of evidence is not evidence of absence”

Final Thoughts

- Applying the SER process in natural resource/ecosystem management will be challenging for a range of reasons, but...
- 20 years ago, researchers trying to synthesize evidence in clinical medicine faced many challenges and naysayers too.
- Conservation SERs piloted in UK: Center for Evidence-based Conservation (emulates Cochrane Collaboration)
- The SER process has significant potential for applying scientific knowledge about ecosystems to policymaking.
- Analysis and conclusions in SER report should be *tested*, by trying a pilot SER.

Thanks to ODF and Reviewers

http://inr.oregonstate.edu/download/ser_report_final.pdf

