Oregon State University

Institute for Natural Resources

Oregon State University, 234 Strand Agricultural Hall | Corvallis, Oregon 97331

Phone 541-737-9918 | Fax 541-737-1887 | http://inr.oregonstate.edu

Document 4a

For the 23 February 2024 IRST Meeting

Standards for Best Available Science: Amendment Information

NOTE: This document is further information to inform some of the below-mentioned amendment possibilities.

The IRST's *Standards for Best Available Science: A Guidance Document* was approved by the IRST during a public meeting on January 19, 2024, with the understanding that the IRST will consider amendments to the following items in February and/or March 2024:

- Distinguish between research and monitoring;
- Add a section on researchable questions;
- Refine the set of principles regarding the quality of scientific work;
- Determine if the IRST should crosswalk this document with the IRST charter (the role of external experts in providing information);
- Add definitions for the categories in the section on types and sources of available science;
- Ask an expert to review the indigenous knowledge section; and,
- Establish a process for peer review (consider the CMER process as a template).

Research and Monitoring

Initial IRST input (November 2023): What is a research question?

Note: The below bullet points are the consolidated IRST responses to questions from the November 2023 intake questionnaire regarding what a research question is. INR did not attempt to incorporate these into the text of the following sub-section so that the IRST can see some of their initial responses to the November 2023 questions; and (2) so that the IRST can collaborate to refine their definition, context, and examples of "What is a researchable question?" based on this and the above input.

IRST consolidated responses to "What is a research question?"

- A "research question" implies that there is need for science discovery and the addition of new knowledge. Sometimes, research questions are not "researchable", meaning we either do not yet have the technology or baseline fundamental understanding to be able to answer the question (e.g., "Where did life come from?"). Fundamentally, a research question requires a testable hypothesis, with data collection and analysis that is transparent and could be repeated by another researcher.
- A research question is clear, specific, and concise. It aims to build understanding of the unknown or uncertain. It would often aim to understand the influence of specific factors on an outcome, for example.
- A specific question stated as a hypothesis or a knowledge gap that can be addressed by a designed study, field survey, modeling, literature review, or another means of scientific inquiry. In this context, research questions would relate predominantly to species, processes, or management effectiveness.

- A research question arises from gaps in previous studies and can be explicitly defined, with an expected outcome/answer that advances understanding of a specific subject. Generally proposed by a qualified researcher in the field.

NOTE: INR approached Becky Flitcroft based on her input at the 22 January 2024 Joint AMPC-IRST Meeting (conversation 0:58 min - 1:05 in the 22 January meeting video) and information from a literature that Jeff Behan provided on the types of monitoring associated with adaptive management. INR asked Becky to review a verbatim transcript of what she said at the meeting, sent her the monitoring definitions, and requested her input as a written starting point for IRST discussion to amend the standards of BAS guidance document to include information on research, monitoring, and researchable questions.

What is Research?

Research contributes to the development of new knowledge to answer questions not well understood in the broader scientific literature. Research is designed to answer "why" questions. New knowledge creation may include the development of new tools, methods, or approaches to answering questions as well as new insights into physical and biological phenomena.

Research generally falls into two scientific categories: applied and basic. Applied scientific research generally has a direct relationship with some form of management or land use action. For example, research exploring the effects of river restoration (a management action) on fish or amphibians would be applied science. Basic science generally explores fundamental relationships that allow us to understand how systems work. For example, exploring how amphibians use habitat patches along corridors is an example of basic science (it becomes applied science when we want to understand how habitat patches created by land use, such as timber harvest, affect amphibian movement).

Applied or basic research requires the use of clear hypotheses (e.g., researchable questions) that are explored using transparent methods, often using a null hypothesis-based framework. It is critical that all aspects of a research effort are described and communicated in a way that can be repeated by others, and with enough detail to evaluate the robustness of the design and the relevance of the results through peer review.

What is Monitoring?

Monitoring is key to adaptive management, providing an empirical understanding of the effects of management over time. Monitoring relies on insights developed by basic and applied research investigations. Effective monitoring does not generally develop new knowledge in the form of "why" questions, but can answer a variety of other questions, often associated with trends over time, or related to the outcome of specific management actions. Different types of monitoring are defined in the literature:

- **Implementation monitoring** – "Implementation (including compliance) monitoring asks whether designed strategies are being followed (e.g., Does stand-level retention meet target levels?)" (Price & Daust 2009).
- **Effectiveness monitoring** – "asks whether objectives are being met (e.g., Are old-growth species maintained in the stands with target levels of retention?)" (Price & Daust 2009).
- **Validation monitoring:** "(or monitoring to learn) investigates the relationship between implemented strategies and objectives (e.g., Are the old-growth species maintained in the stands because of stand-level or landscape-level retention?)" (Price & Daust 2009)
- **Surveillance monitoring** – "Well-distributed (geographically stratified) locations are surveyed repeatedly across years in an on-going effort to uncover trends in target response variables...the purpose of this type of monitoring is to assess whether any change in a response variable exceeds some pre-determined threshold requiring management action" (Hutto and Belote 2013).

- **Ecological effects monitoring** – "Ecological effects monitoring seeks to uncover unintended ecological consequences of management activity and should be an integral part of any program designed to monitor management practices…Explicitly considering and monitoring potential ecological effects will help agencies and stakeholders make more informed decisions to minimize tradeoffs, seek complementarities among values, and optimize benefits among objectives" (Hutto and Belote 2013).
- **Adaptive monitoring** – "A fundamental part of the adaptive monitoring paradigm is that the question setting, experimental design, data collection, analysis and interpretation are iterative steps…A monitoring program can then evolve and develop in response to new information or new questions" (Lindenmayer and Likens 2009).

References

DeLuca, T.H., G.H. Aplet, B. Wilmer, and J. Burchfield. 2010. The unknown trajectory of forest restoration: A call for ecosystem monitoring. *Journal of Forestry* 108(6): 288–295. September. Weblink to article.

Hutto, R., and R.T. Belote. 2013. Distinguishing four types of monitoring based on the questions they address. *Forest Ecology and Management* 289: 183–189. https://www.sciencedirect.com/science/article/pii/S037811271200602O?via%3Dihub

Lindenmayer, D.B., and G.E. Likens. 2009. Adaptive monitoring: a new paradigm for long-term research and monitoring. *Trends in Ecology and Evolution* 24: 482–486. https://www.sciencedirect.com/science/article/abs/pii/S0169534709001219

Price, K. and D. Daust. 2009. Making monitoring manageable: a framework to guide learning. *Canadian Journal of Forest Research* 39(10): 1881–1892. https://doi.org/10.1139/X09-101

Researchable Questions

Initial IRST input (November 2023): What is a researchable question?

Note: The below bullet points are the consolidated IRST responses to questions from the November 2023 intake questionnaire regarding what a researchable question is. INR did not attempt to incorporate these into the text of the following sub-section so that: (1) the IRST can see some of their initial responses to the Nov 2023 questions; and (2) so that the IRST can collaborate to refine their definition, context, and examples of "What is a researchable question?"

IRST consolidated responses to "What is a researchable question?"

- A researchable question is a tractable "research question". This means that there are statistical methods, data collection methods, analysis techniques, that are available to answer the question. Sometimes, new techniques must be developed, and very often that novel technique is its own researchable question.
- A researchable question is one that is suitable for answering through scientific inquiry, i.e., with a testable hypothesis, and use of the scientific method.
- A researchable question must be able to be answered by a reasonable amount of research/resources and addressed through collection of data, analysis and interpretation (uses the process of science to generate evidence for or in conflict with a hypothesis).

- A researchable question is a general question that may be posed by the public, managers, or researchers that is not narrowly defined in scope or location but is valuable to provide information about a site or sites, or resolving a management issue. Researchable questions will require narrowing of scope and definition of goal and outcome, discovery and application of previous work, and development of a specific focus by qualified researchers in the field.
- In this context, a question of science that is capable of being studied using the methods described above. An "unresearchable" question would fall into the realm of opinion, policy, ideology, etc.

What is a researchable question?

Note: Input from Becky as part of the research and monitoring request above. This does not incorporate the IRST consolidated responses regarding what a researchable question is.

A researchable question may represent an individual topic to be tested or frame a series of related topics that are individually tested. In either case, an effective researchable question is specific enough to be quantified and tested through analysis supported by robust project design. Researchable questions may form hypotheses (e.g., questions that can be tested), using a diverse array of statistical tools that depend on factors such as sample design, sample size, and the time frame of the project. Study design, statistical analysis and results all rely on the researchable question that is being asked.

A researchable question guides the development of either research or monitoring efforts. Effective research and monitoring questions clearly frame the parameters of the effort by isolating what is being explored. Well-designed research and monitoring questions provide transparency in what can be learned through the effort. For example, most monitoring efforts will not answer "why" questions. Ideally, monitoring will inform management of changes and trends in different aspects of the system being evaluated. This compares to research questions that, when answered, may inform why specific trends are observed, or provide substantive support for the development of specific and targeted metrics to be followed using monitoring.

A poor researchable question uses terms that cannot be quantified, or that can be interpreted differently by different individuals. For example, terms such as resilience, healthy, effective, or natural lack specificity, and as stand-alone terms, cannot be measured or assessed. Researchable questions can provide the level of specificity needed to quantify and assess elements of health and resilience.

> A <u>non-specific</u> researchable question:
>
> *What is the health of riparian forests over time?*
>
> A <u>specific</u> researchable question:
>
> *How does canopy cover, air temperature, soil moisture and downed wood change over time in managed compared with unmanaged riparian forests?*

In the specific researchable question, the terms canopy cover, air temperature, soil moisture and downed wood are used (rather than "health" in the non-specific researchable question). Likewise, the specific researchable question includes the comparison of managed and unmanaged riparian forests, compared with simply riparian forests in the non-specific researchable question.

In the above example of a specific researchable question, there are four aspects of the riparian forest that are offered for exploration (canopy cover, air temperature, soil moisture and downed wood). There may be companion

researchable questions developed for each one, or for interactions among components of the riparian forest environment being explored.

Defining and Assessing Science Quality

Note: The "quality principles" listed below is original text in the approved BAS guidance. The IRST wanted to look at refining these principles, so we've listed them here for convenience.

Quality principles (original text in the approved BAS guidance (meeting Document 3))

The scientific method aims to produce verifiable and replicable results, which requires identifying a clear objective, proper data collection and analysis methodologies, and the logical explanation of conclusions and limitations. The following list is a set of principles the IRST intends to use to assess the quality of scientific studies (the first six apply to both planned and completed studies, and the final three only to completed studies):

1. Clear statement of the scope and objective(s) of the study, and definition of the research problem;
2. A conceptual model, which is a framework for characterizing systems, stating assumptions, making predictions, and testing hypotheses;
3. Complete and thorough references and acknowledgement of previous work by others and the author(s);
4. Detailed description/documentation of methods;
5. Appropriate experimental design and a standardized method for collecting data;
6. Application of proper research techniques, including whatever chemical, physical and/or statistical parameters/data are appropriate to the subject/study;
7. Recency of the work;
8. Statistical rigor and sound logic for analysis and interpretation; acknowledgement of uncertainties; and
9. Clear statements of findings, reasonable conclusions based on the data collected, questions left unresolved, and questions for further investigation.

The types of sources of available science

From Jeff Behan's summary of BAS (PDF p.7).

- ***Peer-reviewed literature*** includes scientific journals and books where different scientists contribute individual chapters. These are considered the most reliable sources of scientific knowledge mainly because they have undergone independent peer review. These sources are also readily available (at least to the scientific community), often online and in a standardized format.
- ***Gray literature*** may include reports of surveys, experimental or long-term historical data and changes in protocols, metadata, knowledge syntheses, and the progress and findings of monitoring efforts. Such literature may be reviewed internally, e.g. by other agency scientists, but typically does not contain significantly new findings that would require broader or more independent review. Much of this science information is quite accessible. A good example is USFS General Technical Reports (GTRs).

  Theses and dissertations are another type of gray literature. Graduate student research findings may or may not be published in peer-reviewed science journals. In some cases, the original thesis or dissertation may be the only source of unique and otherwise unavailable science information. As of 2023, many scientific theses and dissertations are available via electronic databases such as OSU Scholars Archive, University of Oregon Scholars' Bank, and University of Washington ResearchWorks Archive. Additional

effort is often needed to assess the veracity of science information from unpublished theses and dissertations that have not been subjected to science journal peer-review.

- ***Expert knowledge*** supplied by professional experts can be highly reliable, especially when it is based on the experience of multiple experts who collectively function as peer reviewers. Expert knowledge may be the only science knowledge available.

- ***Anecdotal evidence*** is essentially a short narrative about personal experience. In natural resource and environmental management, anecdotal evidence often emerges through public comments on government reports (e.g. a draft EIS), at agency meetings, through newspaper or popular journal coverage, or through letters sent to agencies or the media. Scientists often put much less credence in this type of information because it can be difficult to access, verify, and review even when generated by the scientific community itself. However, especially when there is a paucity of other types of information, anecdotal evidence can still prove useful (Sullivan et al. 2006).

The IRST believes that all these sources should be considered as appropriate for the research questions, and that all will require consideration of the quality principles described above.

Indigenous knowledge

Text as in the IRST Standards of BAS Guidance Document (Jan 2024)

The IRST recognizes and acknowledges that indigenous knowledge, or other forms of knowing, may make valuable contributions to answering research questions. The IRST does not currently have a formal approach to integrate indigenous knowledge but will continue to explore and develop such procedures. "Two-Eyed Seeing" is a relevant concept, which seeks to examine questions using both indigenous knowledge and positivist science perspectives.

Input from Dr. Cristina Eisenberg in response to Lisa Gaines' request (not on behalf of the IRST) to comment/edit/add perspective on the indigenous knowledge paragraph.

> **Indigenous knowledge**
>
> The IRST recognizes and acknowledges that Indigenous Knowledge (IK), or other forms of knowing, ~~may~~ make essential ~~valuable~~ contributions to answering research questions. The IRST does not currently have a formal approach to ~~integrate indigenous knowledge~~ IK but will continue to explore and develop such procedures. "Two-Eyed Seeing" is a relevant concept that brings together ~~which seeks to examine questions using both~~ IK ~~indigenous knowledge~~ and Western ~~positivist~~ Science perspectives to examine questions working in partnership with Tribal Nations.

"Please note that my edits are in keeping with very recent White House and Dept of Ag policies about communicating about IK. Some key points: The US federal govt now defines IK as "essential" knowledge. In order to incorporate IK into research, one must have some form of partnership with a Tribal Nation, because IK is proprietary. This involves an MOU typically, and such relationships are typically referred to "co-stewardship" partnerships in ecocultural restoration. This is a bit more information for you, to give you some context. This is some of the policy work that I'm working with the White House on. Here is a link to a recent NOI filed in the Federal Register regarding management of US old-growth forest, where you can see some of this language. https://www.fs.usda.gov/about-agency/newsroom/releases/usda-proposes-first-its-kind-national-forest-plan-amendment-conserve

There are many other federal White House CEQ documents available that have been published recently (e.g., joint secretarial orders, executive orders, memos) that also describe such partnerships. https://www.whitehouse.gov/wp-content/uploads/2022/12/OSTP-CEQ-IK-Guidance.pdf "

Uncertainty

Note: The below bullet points are the consolidated IRST responses to questions from the Nov 2023 intake questionnaire regarding "uncertainty". Though uncertainty was mentioned in the IRST-AMPC joint meeting in January 2024, it has not yet been discussed in terms of a section within the IRST's best available science guidance document.

IRST consolidated responses from the Nov 2023 intake questionnaire about defining uncertainty or the most important aspects of uncertainty for the IRST to address

- Scientific uncertainty includes physical, biological, and social science topics (the social uncertainty described here seems like something a social scientist could possibly quantify). How any specific topic is researched or monitored ties closely to the uncertainty that we have about the findings. This is a fundamental aspect of statistical analysis that provides a framework to understand imperfect data collection. Ideally, we'd be able to always have census of available data to understand a question, but that is generally the exception and not the rule. As such, sample size, sample design, and statistical analysis work together to inform our understanding of the merits of a research or monitoring product. The IRST can focus on some specific elements here:
    1) Tractability of a research project through evaluation of study plans and research proposals,
    2) Sample size to answer questions, and
    3) Sample design and links to research goals.

  Many of these topics should be part of the research proposal that's developed by the IRST.

- The role of the IRST, and the AMP overall, should be to address scientific uncertainty. Within that, though difficult, our greatest challenge is to address uncertainty regarding cause-effect linkages between forest management and effects on aquatic resource – that is going beyond simply measuring change in the environment, and instead interpreting whether observed changes have meaningful ecological effects on fish and amphibian populations.

- From the perspective of the IRST, the IRST should address uncertainty throughout the adaptive management process. Uncertainty in whether the forest practice measures meet the biological objectives becomes a research question for example. We use the scientific process and measures of variability or knowledge gaps to identify areas of uncertainty.

- Generally, science may be specific to a particular site, but outcomes may vary from location to location. Also, the very nature of science is uncertain—with new technologies and techniques, and applications of other studies, understanding of a place, subject or mechanism will change. Furthermore, application of any finding or expected outcome to any particular location/problem in the natural world will change as conditions change. Especially now, we live on a planet that is changing rapidly, often outside of the scope of previous studies/predictions. We should expect that outcomes and management will need to change (adapt!) sometimes rapidly and radically.

- In the context of the PFA and draft HCP, scientific uncertainty is the most important to address. For previously well-studied species, how management affects the creation and maintenance of their habitats, given underlying environmental variability is of primary interest. Reducing scientific uncertainty for less-well understood species is also a key area of inquiry. Reducing scientific uncertainty regarding climate

change by downscaling models and examining how habitats and species are likely to respond in the face of management will be critical over the long term.

Based on the input received from the intake questionnaire, INR has drafted the following statement on uncertainty for consideration and review by the IRST:

Uncertainty (Draft text for BAS guidance)

A key role of the IRST and AMP is to address scientific uncertainty. The scientific process, measures of variability or knowledge gaps, and how a topic is researched and monitored can help identify areas of uncertainty as well as influence our understanding of uncertainty associated with the findings and thus the merits of a project.

A key challenge will be addressing uncertainty regarding cause-effect linkages between forest management and effects on aquatic resources, i.e., interpreting whether observed changes have meaningful ecological effects on fish and amphibian populations. Key areas of inquiry will likely include how management affects the creation and maintenance of previously well-studied species and their habitats with a context of environmental variability, reducing scientific uncertainty for less-well understood species, and reducing scientific uncertainty regarding climate change by downscaling models and examining how habitats and species are likely to respond in the face of management will be critical over the long term.

Tractability of a research project through evaluation of study plans and research proposals, sample size to answer questions, and sample design and links to research goals should be core elements of any research proposed by the IRST.

Role of External Experts in Providing Information (Draft text for BAS guidance)

External experts will be consulted in the peer review of IRST-commissioned research reports (as described in a separate subsection ~~below~~), but they may also be engaged in other phases of IRST work, such as the refining of research questions, review of available literature, preparation of requests for proposals (RFPs), and selection of research to fund. When engaging outside experts, the IRST must avoid any conflicts of interest, such as providing unfair advantages in information or influence to potential RFP applicants. Any entity participating in the ~~formal~~ IRST's internal development of an RFP (i.e. outside "requests for information" or other public input opportunities) is not eligible to respond to that RFP.

Individual IRST members may contact external experts to solicit information related to AMP research topics/questions, but they are encouraged to advise other IRST members and share results (through the Housing Agency) to prevent duplication and provide all members with equal information. The IRST may also decide as a group to solicit external expertise by either assigning an IRST member to make contact, inviting experts to IRST meetings, or requesting written feedback or reviews. IRST may also form subcommittees that include external experts, as described in the IRST Charter (section II.5). Experts may be compensated for their time from IRST research funds, but any payment for services is a substantial decision that must be voted on by the IRST.

~~Peer review (Draft text for BAS guidance)~~

~~What Will Be Reviewed~~

The AMP rules require "A peer review process that is transparent and addresses both study designs and study reports. Based on discussion in the IRST 9 Jan 2024 meeting, this peer review clause was intended to apply to the research products commissioned by the IRST.

IRST Preliminary Review

The IRST will provide a preliminary review of each research report as it is received and decide whether further information is needed from the authors to facilitate the peer review process. The Housing Agency will pass on any requests to the authors and distribute responses back to the IRST.

Selection of Reviewers

The IRST will arrange peer reviews of research products from individuals with the appropriate topic expertise, which in some cases may be IRST members themselves and in other cases will be outside experts. When a research project is nearing completion, the IRST will discuss and provide the names of any recommended reviewers to the Housing Agency. The Housing Agency will research and provide additional reviewer names if requested. Given a goal of two independent reviews, a list of four or more potential reviewers is recommended. Reviewers may be offered financial compensation at the discretion of the IRST.

Peer Review

Once the IRST decides that a research report is ready for peer review, they will discuss and provide any specific questions that they wish to pass on to reviewers and a target timeline for the review. The Housing Agency will contact reviewers in the list until two have accepted and will manage the collection of reviews. Per the AMP rules, "the IRST shall not grant anonymity to authors, handling editors, or peer reviewers before January 1, 2028. After January 1, 2028, the IRST may modify the anonymity requirements to peer reviewers by a substantial decision of the IRST" [629-603-0400(4)(d)].

Post-review

IRST will assess the reviews and decide whether any responses are needed from the report authors, which may include revisions to the report or less formal comments/clarifications. The Housing Agency will request any responses from authors and forward these back to the IRST for further assessment. Once the IRST is satisfied with the reviews and any author responses, the report will be considered final for the 30-day report delivery timeline specified in the rules [629-603-0200(7)]. The IRST may formulate a memo to accompany the report and reviews when they are submitted to the AMPC and Board of Forestry.