

Evaluating “Test and Remove” as a management tool to overcome the effects of disease in bighorn sheep

Test and Remove Working Group of the Wild Sheep Initiative: Frances Cassirer (Idaho - Chair), Daryl Lutz (Wyoming), Brent Lonner (Montana), Mike Cox (Nevada), Emily Almberg (Montana), Kate Huyvaert (Washington State University), Chris Procter (British Columbia, CA)

INTRODUCTION

Wildlife management agencies have implemented many different actions for disease control and mitigation in bighorn sheep or, in some situations have made the decision to take no action. Within the last few decades, an improved understanding of the causes of pneumonia outbreaks and persistence in bighorn sheep has led to the development of “Test and Remove” (T&R). Test and Remove is a management intervention that has been used for more than 10 years to detect and remove chronic carriers of *Mycoplasma ovipneumoniae* to improve bighorn sheep survival (particularly lamb survival) in persistently infected populations where recruitment is low and respiratory disease (pneumonia) is a limiting factor. Test & Remove has been, or is being, implemented by wildlife management agencies in at least 26 bighorn sheep populations under widely differing circumstances: varying population sizes and spatial structure, accessibility, prevalence of infection, number of strains circulating, number of years post-outbreak, habitats, native and reintroduced populations, etc. Management agencies have also applied different procedures and sideboards, including testing labs and protocols, sampling intensity and periodicity, as well as selection criteria for lethal removal (i.e., one vs. two or more positive tests).

So far, results of T&R have been mixed. Some applications have been successful in increasing lamb survival and allowing for population recovery, while others have not. In addition, most T&R efforts are inherently expensive and time-consuming, can be impactful to the bighorn sheep themselves and to sheep populations, and come with varying levels of public support. Given these factors and the combined experiences and outcomes of T&R projects currently being conducted throughout wild sheep range in the USA and Canada, there is an opportunity to better understand and evaluate this management tool, and the underlying assumptions and processes associated with detecting chronic infection, by conducting a meta-analysis.

In January 2025, the Wild Sheep Initiative and the Wild Sheep Foundation hosted “Test and Remove Workshop 3.0”. This workshop was attended by representatives of various disciplines including wildlife managers, researchers, veterinarians, pathologists, disease ecologists, and other interested parties. Nearly all WAFWA agencies were represented either in person or virtually. During the workshop, the idea for combining forces and sharing information about T&R was presented and discussed, and those in attendance agreed that there is significant value in conducting a meta-analysis to better understand the impact T&R has had on population health, the circumstances under which it is most likely to succeed, and how to ensure that it is most effective and efficient in future applications.

OBJECTIVES

An outcome of the T&R Workshop 3.0 was the creation of the “Test and Remove Management and Meta-analysis Working Group” of the Wild Sheep Initiative. The objectives of the Working Group are to;

- Identify questions to address collectively using data and experiences from conducting T&R in bighorn sheep populations range-wide;
- Develop a process and timeline for implementation of a meta-analysis to tackle these questions;
- Oversee the analysis and supervise a research or post-doctoral scientist who will assemble the data and conduct analyses, and;
- Throughout the process solicit feedback from field biologists, Wild Sheep Initiative representatives, the Wildlife Health Committee and a research advisory group, and revise project direction as needed.

EXPECTED OUTCOMES

The proposed meta-analysis will assimilate data from T&R programs across jurisdictions to provide insights into what has and has not worked and why given the varying circumstances in which T&R has been implemented. The results of this project will be communicated in a final report to WAFWA, presentations to wildlife managers, and publication in peer-reviewed journals and other outlets and will include:

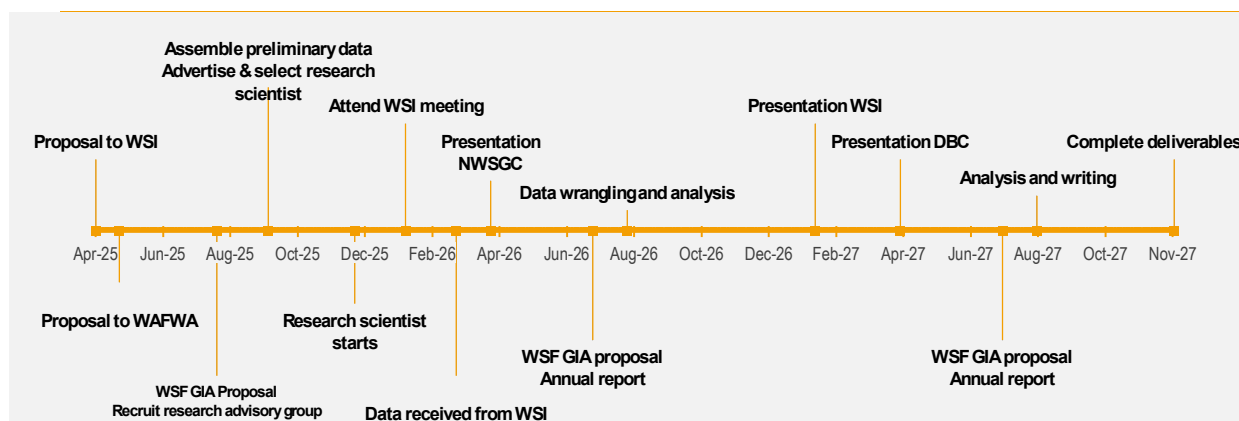
1. A summary of the various conditions and protocols under which each jurisdiction conducts T&R and the outcomes;
2. An assessment of factors associated with disease clearance, improvements to survival, and population recovery;
3. A synthesis/evaluation of costs and benefits of T&R;
4. Recommendations for improving T&R effectiveness and efficiency for disease and population management;
5. Refinement of the WAFWA/WSI 'Test and Remove User Guide';
6. A better working model of pneumonia persistence in bighorn sheep populations; and
7. Possible development of an online application to assist managers with evaluating whether T&R is an appropriate management tool under various conditions.

Members of the Wild Sheep Initiative, the Wildlife Health Committee, and the Test and Remove Working group will provide the initial and ongoing direction for the project. We are also proposing to consult with specialists (to be determined) in disciplines such as disease ecology, microbiology, immunology, as well as landscape, social, movement, and nutritional ecology to get input on how to fully address the range of factors that we are dealing with that can influence pathogen persistence and transmission when conducting T&R. To help accomplish this work, we are proposing to hire a research scientist dedicated to this project for a period of two years. This person's responsibilities will be to:

- Coordinate with state and provincial wildlife agencies, the WSI, Wildlife Health Committee, universities, researchers, the T&R working group and others to identify information needs and gather the necessary data from each of the T&R projects.

- Ensure there are no conflicts associated with data being used for other ongoing research projects and comply with all data-sharing protocols;
- Clean, assemble, and combine data into a relational database;
 - Summarize data and coordinate with the data providers to resolve errors and omissions
- Coordinate with the T&R Working Group and research advisors to identify and conduct appropriate analyses;
- Evaluate T&R efficacy and formulate recommendations for future implementation;
 - Consider all co-variates potentially affecting T&R outcomes
- Update the WAFWA T&R User Guide;
- Write detailed annual and final reports for WAFWA, WSI, and any other contributors;
- Evaluate the efficacy of an online user application to assist managers who are considering using T&R; and
- Publish results in a peer-reviewed journal.

TIMELINE



BUDGET

	Year 1	Year 2	Total
Salary (Research Scientist/post-doc)	\$65,000.00	\$65,000.00	\$130,000.00
Benefits (estimated high at 50% of Salary)	\$32,500.00	\$32,500.00	\$65,000.00
Overhead (0 – 20%, estimated high)	\$18,000.00	\$18,000.00	\$36,000.00
Computer and Library Access	\$3,000.00	\$1,500.00	\$4,500.00
Travel	\$1,500.00	\$3,000.00	\$4,500.00
Misc. supplies	\$1,000.00	\$1,000.00	\$2,000.00
Publication costs		\$3,000.00	\$3,000.00
Total	\$121,000.00	\$124,000.00	\$245,000.00