Appendix C: Working Group A — THE ULTIMATE STUDY

Leaders:	***Elena Garde, Craig Stephen***
Facilitator:	***Jonna Mazet***
Recorder:	***Jennifer Schultz***
Members:	***Trevor Ames***
	Walter Boyce
	Marie Bulgin
	Mary Conner
	Mark Drew
	Lisa Shender
	Steven Torres

Day One:

Brief meeting led by Craig Stephen. Group members encouraged to think tonight about two things:

1. Defining the critical question
2. What do we need to know to answer the critical question? (Take into account what we already know, what we need to know, and how would further research be funded).

Day Two:

Ultimately, what we want to know is ….. (The ultimate question)

- How to manage bighorn sheep populations for health and persistence
- What does a healthy population of bighorn sheep look like? What exactly are we trying to achieve with management? What is acceptable herd size and mortality rate? We may need to know this before we start to determine risk factors.
- Do domestic sheep in typical grazing patterns result in infection of bighorn herds when they overlap in space and/or time? Have any studies been done in typical field conditions?

- What are the environmental factors contributing to bighorn sheep die-offs?
- What are some of the common factors and differences between bighorn sheep populations in different geographic regions that contribute to disease/health and how can we document theses factors in a standardized manner?
- How to measure impact of disease on bighorn sheep populations, and how to quantitatively measure impact of disease.
- What triggers/levels of measurement values mandate management actions in bighorn sheep? What drives decisions?
- Do bighorn sheep contact domestic livestock in current grazing strategies? We have no way to document this contact.
- How big a problem are translocations of bighorn sheep on resident populations? (Example of Hell's Canyon) Different populations tend to have different populations of bacteria; sharing of pathogens will occur.
- Standardized approach to health assessment in bighorn sheep at capture and historical risk assessment. Standardized procedures protocol is complicated. (Example: PI3 result not verified in bighorn sheep, so how do we interpret it?)
- Verification of methods and interpretation of diagnostic tests in bighorn sheep.
- The problem is a failure to agree on the problem to be solved. Will science ever solve this problem? Sociologically, politically, and culturally, are we unprepared to deal with the available possible solution? What is an acceptable solution between different groups that will maximize chances of persistence of wild sheep?

Comments:

This is a sociological issue and a value-based situation. The key part is persistence of wild sheep. How do we get to the point of making a decision to permit persistence of wild sheep? How do we keep them apart in a way that will be **acceptable**?

- If we knew how they got the disease, would that make a difference in how we act?
- Is this an oversimplification? Disease outbreaks occur in absence of contact. Contact is a risk factor, but not the driving factor.
- Domestic sheep are an important risk factor. We need animals on the ground to keep habitat for bighorn sheep.
- There are also important historical and cultural issues involved.
- Livestock owners don't want to be responsible for the demise of bighorn sheep. If we could prove to them that domestic sheep were responsible, we would see less reluctance to give up certain ranges. They are a small segment of the population, and feel they are being attacked. Convincing

livestock owners would take some pressure off government. It could be beneficial to influence leaders in the sheep industry.

- We are dealing with a dichotomy. We could focus on what constitutes a healthy bighorn sheep population, or we could focus on a specific disease issue.
- We have to distinguish what information we need to know from what we want to know.

What is our purpose? Why are we doing this science? How do we manage for health and persistence, and what do we need to know to get there?

Knowledge gaps:

1. What is a healthy population? Everybody has a different perception. In the cattle industry, there is a pretty standard perception, but it is based on economics.
2. What are measurable outcomes?
    - Sustainable. Populations fluctuate, so we must distinguish between natural fluctuation and something more precipitous. There is not an easy way to define a healthy bighorn sheep population, but they exist. We can't use many of the common parameters to manage bighorn sheep. We manage by how many populations there are, and how they are connected (metapopulation monitoring).
    - Some societal utilities: huntable populations, connectivity between groups (genetic diversity), numbers of populations, recruitment.

Persistence is the fundamental unit of health.

Characterize "health":

1. Access to resources for daily living
2. Capacity to cope with change or stress
3. Ability to meet expectations
    - Ecological role—ecologic services
    - Socioeconomic role—culture, hunting

Where does respiratory disease compromise these capacities to maintain a healthy population?

- Solutions and methods must be convincing and socially acceptable.
- "Health" is specific for different areas. Habitat is different, and recruitment and connectivity are different for different populations.

We want to know when disease acts to push a population over the threshold to create an unhealthy population. Disease may play a small role. Other factors such as habitat changes and predation are involved. Disease can be catastrophic, and respiratory disease in bighorn sheep can cause catastrophic die offs. There also is respiratory disease that is not catastrophic. We don't know why some respiratory disease caused catastrophic events and some does not.

We need to have a standardized protocol coordinated to have trained people collecting proper data in the field. We don't have baselines to answer what is a healthy population. Would it help in distinguishing ongoing from catastrophic events? This baseline information may tell you what you don't have.

Body condition score is important in domestic sheep. Do we even know what habitats are good for bighorn sheep? (Example. What do they really eat?)

Under what condition does respiratory disease result in unsustainable/undesirable population-regulating effects? We must consider management ideas and social issues. We need to know social expectations for health, determinants of sustainability or health, whether risk factors are transportable across different habitats.

We have not established anything wool growers can participate in. We need to give them a way to participate. There is nothing clear to help herdsman know their role in helping to reach the goal. We must show them how the contact is a problem. These things are not defined enough to allow for a socially acceptable solution.

We need to determine what is the most critical question to answer that will get us the furthest along.

How do we measure population regulating effects? We need a measurement point that says there is an effect of whatever is going on. (Example: extirpation of a population, 30% reduction of a population, etc.)

Body count could be used, but this is too late if we are trying to prevent disease. Frequency of new occurrences is another idea.

Die offs often occur in late fall and winter. This sounds like it could even be related to nutrition. Has anybody tried supplementation?

It's a management option, but not viable.

There are situations where contact occurs with die offs, and situations where contact occurs with no die off. There are also die offs with no history of contact between domestic sheep and bighorn sheep. The perception of the domestic sheep people is that all the focus is on domestic sheep contact.

The contact with domestic sheep is at least one thing we can manage. There does seem to be an association. The relative contribution of domestic sheep may vary in different ecosystems.

One problem with reactive management is that when you've acted, you are too late. But, finding predictive indicators may be impossible.

Why don't we have useful predictive indicators of population effects of disease? These predictive indicators must be observable, measurable, repeatable, understandable, predictive, acceptable, and meaningful.

Knowledge deficits	Logistics or social issues (Tools)
SRS models -relationships of population dynamics with probabilities and severity of disease -relationship of herd health indices (body condition,…)	Capacity to collect data in adequate frequency, distribution (spatial) -population dynamics -dead counts -sick sheep
	Decision making in the face on uncertainty
	Equal engagement of all stakeholders

(Figure 1. Predictive indicators of effect on a population)

Should we change our question?

- The issue of domestic and bighorn sheep is not clearly indicated in this question. Decision making in the face of uncertainty.
- Everybody doesn't share the opinion that contact with domestic sheep is a problem. What is the acceptable level of risk?
- Should we initially drop science and take up advocacy?
- Should we resolve the uncertainty first?

As a manager, you must manage resources and be responsive to the public using good science. We have no broad ranging collaborative way of looking at alternative husbandry practices, alternative uses of range, etc. We must identify the obstacles, develop collaborations, and find common ground to get past the obstacles.

Woolgrowers ask for proof that domestic sheep pose a threat, and would be willing to cooperate if there were proof of this problem. The data we currently have is not proof enough.

Funding issues can also be a problem.

(Figure 2. Two components of disease risk: Sociology and Biology)

New question:

How does science help resolve environmental conflicts?

- Nature of consensus and conflict (what is the threshold of proof)
- 2-way risk communication

Can current science solve this conflict?

What is the role of science in conflict resolution? Where do we want to focus our attention? Now (1-2 yrs), Short term (2-10 yrs.), or on the ideal future (10-15 yrs.)?

What would be the best way to spend $1 million to create better management of disease conflicts in bighorn sheep?

- Work with the social component initially. Get the stakeholders together. Find out what evidence is needed to come to an agreement.

Why do people interpret the data differently? Is the data just not that conclusive? Just because we don't have "proof" doesn't necessarily mean we should do nothing. But there are real consequences to taking away allotments.

What makes a good decision?

- Shared goals
- Achievable
- Effective

What are the sources of conflict? Science (the data) vs. Beliefs

Can science affect beliefs?

Can bighorn sheep managers identify what information they need to stand up to a challenge? What would be proof for woolgrowers? Maybe more studies like the Mycoplasma study presented yesterday.

Can we solve this problem with science? There is one risk factor most can agree on (contact with domestic sheep), but how can we make this change with all of the social issues? This is a fundamental problem that needs to be dealt with in the short term.

Designing a study may be impractical or infeasible due to the political and socioeconomic obstacles. The belief system may be so strong that any amount of data will not convince the woolgrowers, even if veterinarians and other domestic sheep influencers are convinced.

Are there scientific obstacles?

- There may be no bighorn sheep population we are willing to sacrifice
- Conditions are not the same in different populations of sheep. Conditions can't be cleanly controlled and replicated.

Science is not going to resolve this. What could we do to move us slightly further forward than status quo?

Nobody is developing tools to study disease in wildlife. We could develop these tools now, but we don't have the money.

The Ultimate Study:

The sociological issues must be addressed before successfully proceeding with the biological aspects of the problem.

(Figure 3. The ultimate study must deal initially with sociological issues, then biological issues)

Part I – A Rigorous Sociological Study of Cross-Cultural Consensus.

WHO: Social scientists, politicians, wool growers, researchers, biologists, disease ecologists/specialists, other stakeholders.

HOW:

- Participatory approach
- Pre-designed: not a one day meeting and a group hug
- Rigorous scientific design

GOALS:

- To articulate a shared vision of obstacles to consensus-trust building and collaboration
- To establish a burden of proof
- To obtain information that assists people in making informed decisions
- To discuss study designs that will influence the majority
- To develop measures of success

If no shared vision→ This is a political issue, and politicians will make the decision.

Part II – A Study of Core Obstacles: Measurable Data

Questions To be Asked

- What does a healthy population look like? (locally, regionally, North America-wide)
- How are we able to achieve management goals and measure success?
- What are acceptable herd sizes and mortality rates?

  -establish risks

  -determine cause and effect studies

  -determine how to measure effects of change on a population

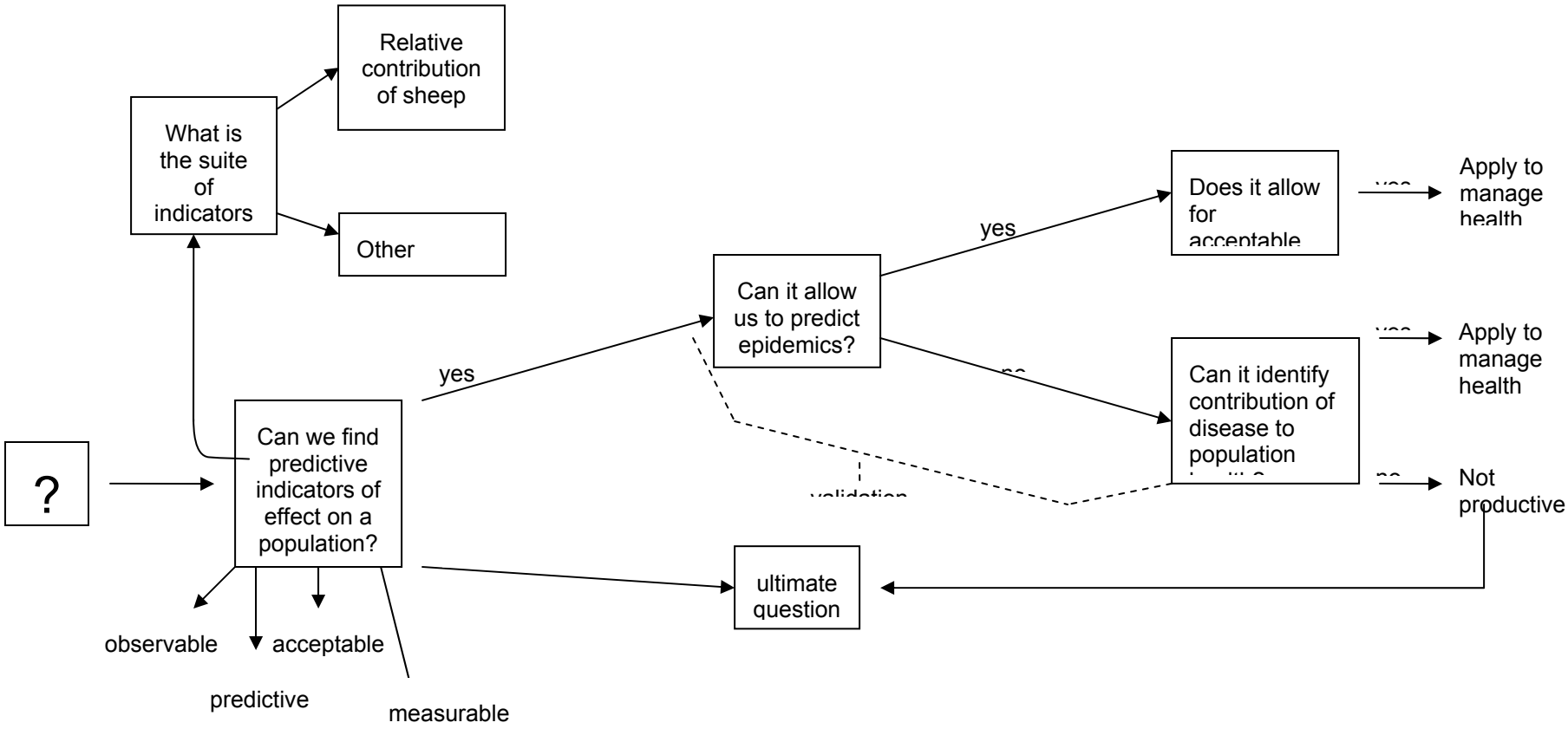

Figure 1. Predictive indicators of an effect on a population must be observable, predictive, measurable, and acceptable. Some, but not all of these indicators will be affected by contact with domestic sheep. If such predictors exist, and they allow us to predict epidemics while also allowing for socially acceptable action, they should be applied to manage health. If a predictive indicator can identify the contribution of disease to population health, it should be applied to manage health, even if it does not allow us to predict epidemics. If we cannot find predictive indicators with the desired characteristics, then we must reevaluate our ultimate question.

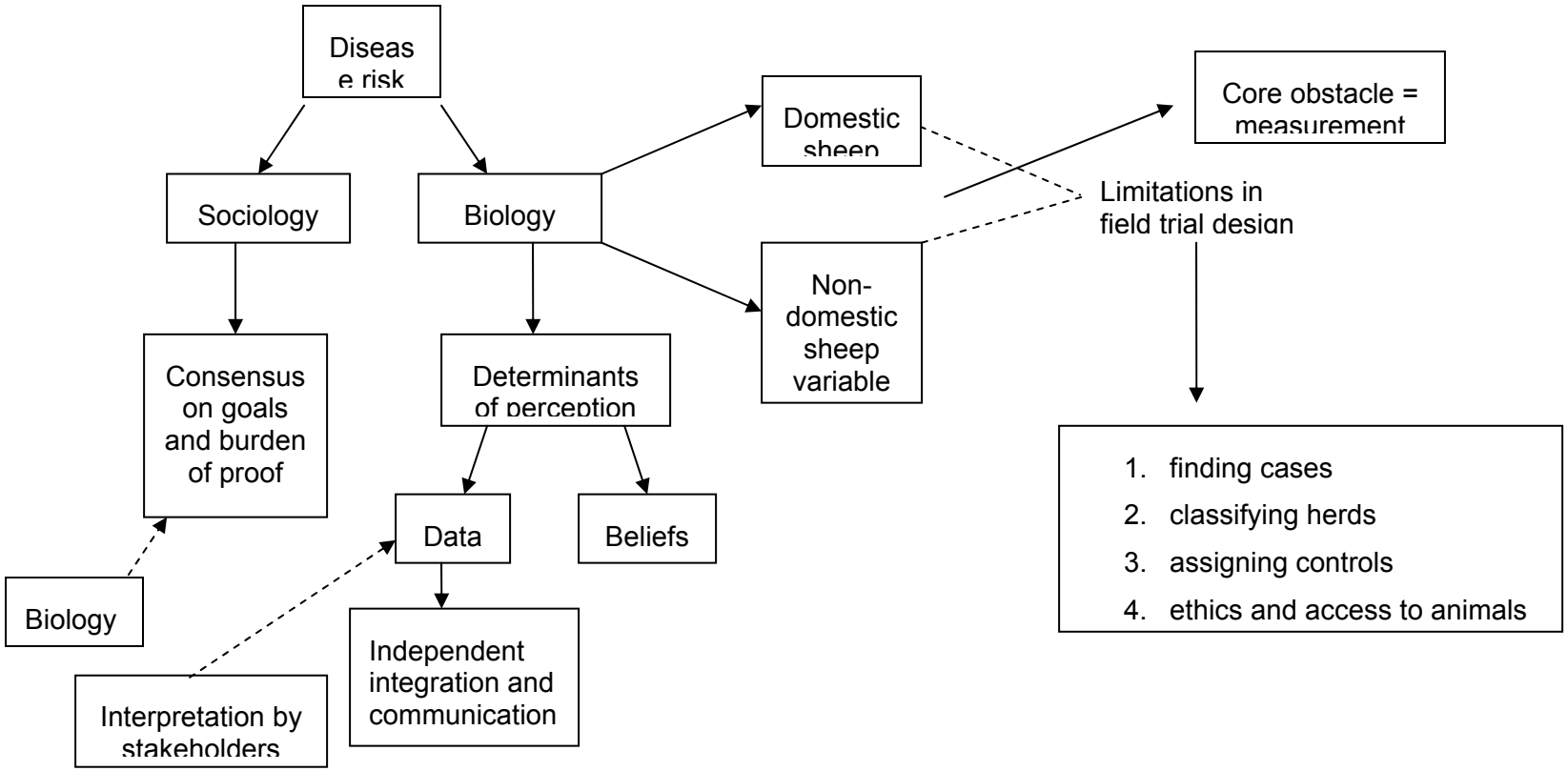

Figure 2. There are two important components to disease risk- sociology and biology. Each component affects the other. Consensus on goals and burden of proof is influenced by biology. Both data and beliefs are determinants of perception in biology, but data may be interpreted differently by stakeholders. There are both domestic sheep and non-domestic sheep variables involved in the effects of disease in bighorn sheep. Finding ways to measure these variables remains a core obstacle. There are also several limitations in field trial design.

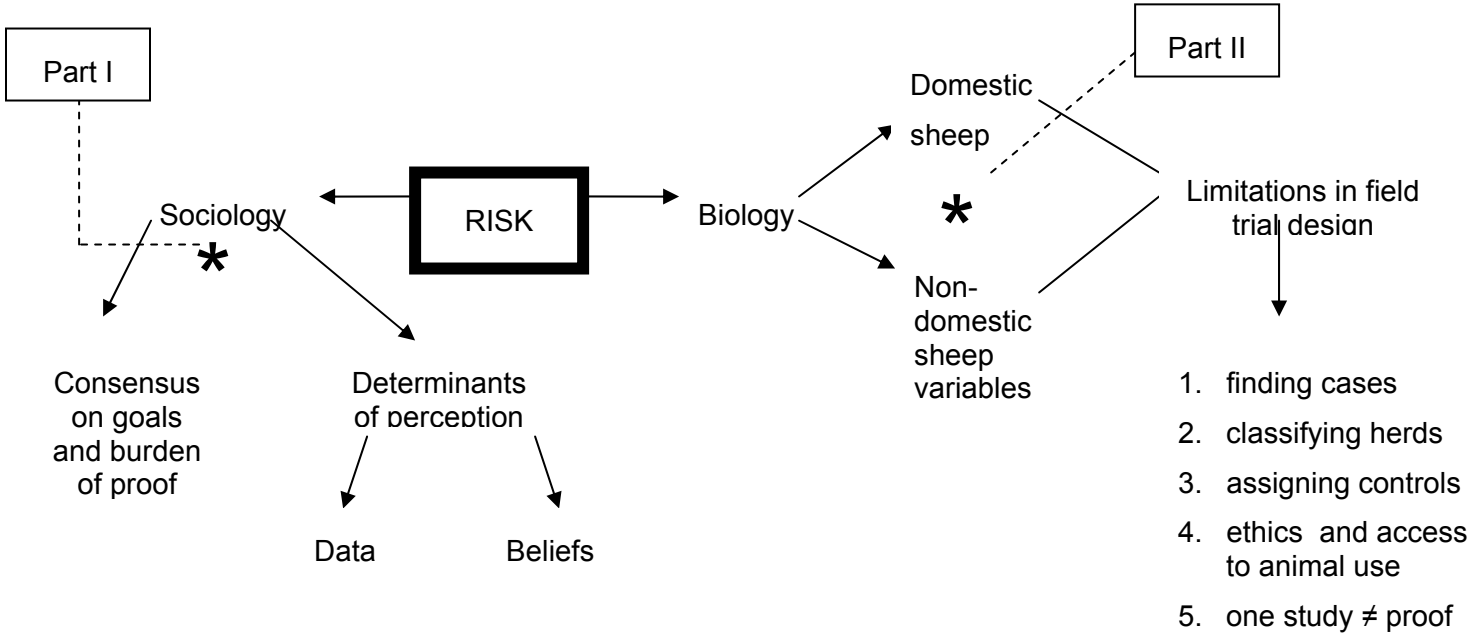

Figure 3. Part I (Sociology) and Part II (Biology) of the ultimate study. Part I consists of a rigorous sociological study to articulate a shared vision of where we have to go to make informed decisions, to establish a burden of proof, and develop measures of success. Only after Part I is completed will Part II be successfully carried out. Part II is a study of the core obstacles to define a healthy population, establish management goals, and develop tools to measure population effects.