West-Wide Adaptive Disease Management Venture (DMV)
Salt Lake City, Utah
October 28-30, 2015

Wednesday, October 28
- Introductions
  - Project Oversight Committee
  - Guests

- West-Wide Adaptive Disease Management Venture (DMV)
  - Background
  - Purpose

- Purpose of meeting

- Researcher presentations/questions:
  - Tom Besser
  - Frances Cassirer
  - Bob Garrott/Carson Butler

- 2011-12 Survey of wild sheep disease events/management actions (Cox-Carlsen)

Thursday, October 29
- 2015 Supplemental Survey (west-wide inventory of bighorn herd history/demographic performance)

- Brainstorm session
  - Identify
    - Common themes
    - Identify herds that can be intensively monitored through proper experimental study designs that are intended to answer key questions on herd performance related to disease events, viable management actions post event, and other needs as identified in the purpose/mission?
    - Measurable/repeatable management actions that have potential to expedite the recovery of herds
    - New and crazy ideas that have potential to expedite the recovery of herds with chronically poor population performance and/or improve our understanding of this complex situation
    -
  - Develop:
    - Project mission statement
    - Goals and objectives
    - Hypotheses

Friday, October 30
- Complete brainstorming session
- Next Steps
- Wrap-up

West-Wide Adaptive Wild Sheep Disease Management Venture
Steering Committee Meeting
October 28-30, 2015, Salt Lake City Utah

Meeting Notes

<u>**Introductions, Overview and Research Presentations**</u>

Welcome/Comments: Greg Sheehan (Director, UT DNR)

Overview: Clay Brewer

- o Project Oversight Committee
  - Peri Wolff (NV)
  - Mike Miller (CO)
  - Helen Schwantje (BC)
  - Justin Shannon (UT)
  - Rich Harris (WA)
  - Mike Cox (NV)
  - Clay Brewer (TX)
  - Emily Almberg (MT)
- o Technical Advisors
  - Frances Cassirer (ID)
  - Tom Besser (WSU)
  - Bob Garrett (Carson Butler)
  - Kevin Hurley (WSF)

- West-Wide Adaptive Disease Management Venture (DMV)
  - o Purpose
    - Improve understanding of herd responses to bighorn sheep pneumonia disease or die-off event and to develop new and evaluate existing and new management actions to prevent or mitigate the impact of these events.
    - Discussion amongst the group led to the following questions and proposals:
      - Why are there different herd responses to the same suite of pathogens?
        - Do we agree that herds really HAVE responded differently?
        - If we disagree on this, let's clarify and document our disagreements, so they become part of the questions to be answered by future research or monitoring.
        - Similarly, do we agree that herds have actually been dealing with the SAME suite of pathogens?
        - This may depend on how we define "Same."
        - As above, if there are different opinions on this, let's get that clarified and documented, so we can track the issue over the next few years.
      - Are there herds that should be monitored more intensively than otherwise planned (a multi-year commitment)?
      - Are there experiments we should undertake now or when a new event occurs, that would provide valuable information?

- Are there effective tools or management options (previously used or new) that can assist wildlife managers in restoring herds from past disease events and chronic or cyclic poor lamb recruitment?

- Can herds be identified (west-wide) that can be intensively monitored through proper experimental study designs that are intended to answer key questions on herd performance related to disease events, viable management actions post event, and other needs as identified in the purpose/mission?

- Do we have director support for project?

- What is the purpose of this meeting Learn from researchers – updates
- Discuss previous disease management actions (what worked and what didn't)
- Brainstorming session
  - Review and discuss supplemental survey of disease events in bighorn herds
  - Identify herds that can be intensively monitored
  - Possible experimental management options
  - New and crazy ideas
- Develop a plan for DMV
  - Overall project goal
  - Objectives
  - Hypotheses
  - Jurisdictional participation
  - Project funding
  - Support – jurisdictional and overarching
  - Next steps

Research Presentations (See appendix A)

Frances Cassirer (IDFG) – Review of project: *Investigating the role of super-shedders in respiratory disease persistence and transmission in bighorn sheep* **(To be provided)**

Tom Besser (WSU) – *Review of M. ovi's role in Bighorn Sheep Pneumonia Complex* **(To be provided)**

Carson Butler (MSU) – *The role of disease, habitat, individual condition and herd attributes on bighorn sheep recruitment and population dynamics in Montana* **(See Appendix A)**

PROJECT GOAL: To provide management actions/tools that result in improved wild sheep population performance in relation to respiratory disease.

OBJECTIVES:
- Verify through standard herd health assessments and enhanced monitoring why some herds respond differently when exposed to respiratory pathogens.

- Determine if there are specific identifiable attributes in herds that contribute to this variation in herd response.
- Standardize the definition of herd structure (for example, does a herd contain sub-herds) and examine population performance in the sub herds.
- Develop, evaluate and validate management actions/tools based on standardized data generated through comparable methods with further assessment of the cost/benefit, logistics, and practicality of each tool.

TASK :

1. Identify and select attributes that potentially impact herd performance in healthy and unhealthy herds (WAFWA/WHC 2014 Bighorn Sheep Health Monitoring Recommendations) and contribute to either increased herd resiliency or increased transmission of disease.

2. Identify enhanced monitoring protocols for these selected attributes

3. Develop list of experimental management actions/tools to evaluate and verify including timing of these management actions in relation to a die-off event (before, during or after).

4. Identify criteria for jurisdictional participation either in enhanced monitoring or experimental management actions.

5. Select sheep herds meeting the identified criteria for participation either in enhanced monitoring or experimental management actions.

6. Implement identified enhanced monitoring and experimental and adaptive management actions.

TASK #1

Identify and select attributes that potentially impact herd performance in healthy and unhealthy herds and contribute to either increased herd resiliency or increased transmission of disease.

- Confirm definition of healthy and unhealthy herds. See Attached Appendix A definitions from (See 2014 WAFWA/WHC Bighorn Sheep Health Monitoring Recommendations)
- List of specific attributes that potentially contribute to variations in herd response to the introduction of a respiratory disease.
  -
  - Introduction of new pathogens or strains of pathogens M. ovi or a new strain of M. ovi)
  - Nutrition (macro and micro nutrients)
  - Genetics (MHC/genomics/NRAMP)
  - Animal density (herd or sub-herd level)
  - Spatial structure – sub-herds ewe/nursery groups , resource distribution
  - Predation
  - Native/remnant vs. introduced
  - Augmentation history, source herd(s)

We began discussion of putting these attributes into 2 categories:
1) Those that contribute to response of herds after disease exposure, and
2) Those that contribute to decreasing risk of a herd getting exposed to pathogens.

Attributes affecting response to Movi infection	Attributes affecting risk of Movi infection
Movi prevalence	
Movi strain	
Density/size	Density/size
Spatial structure	Spatial structure
Augmentation history	Augmentation history
Nutrition	Nutrition
Genetics	Genetics
Predation	Predation

TASK #2
Identify enhanced monitoring protocols for these selected attributes
- See WAFWA/WHC 2014 Bighorn Sheep Health Monitoring Recommendations)

TASK #3
Develop list of experimental management actions/tools to evaluate and verify including timing of these management actions in relation to a die-off event.
- Before (B)
- During (D)
- After (A)

Experimental Management Actions/Tools to Consider (Bolded is what the committee prioritized?)
- **(B,D,A)** Monitor herd with demographics only – no active surveillance.

- **(A) Augmentation of a herd post disease or die-off event with source stock that carries the same M. ovi strain.**

- **(B,D, A) Treatment**
  - Culling
    - **(A) Selective Test and Cull (**Based on repeated standardized testing for a suite of pathogens)
    - (D) Culling during outbreak to create a buffer zone around the herd to try and reduce spread to neighboring herds from dispersing animals.

    - (A) Total Removal - Depopulation to prevent further spread of disease
    - **(A) Total Removal - Depopulation in conjunction with repopulation strategies to remove the original source of disease transmission (domestic sheep/goats or other bighorns), use same source**
  - Vaccination
    - (B) Domestic Goat *Mycoplasma ovipneumoniae* (M. ovi.) Strain as vaccination to existing wild sheep that have a domestic sheep M. ovi. strain

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– needs validation
- o Antibiotics
- o Nutritional or Trace Mineral
- o Anthelmintics

- **(B,D,A) Prevention (To prevent a healthy herd from being exposed to either domestic sheep/goats or a diseased bighorn herd)**
    - o Separation from any domestics or wild unhealthy herds
    - o Remove domestic sheep allotments and farm flocks
    - o Cull wanderers
    - o Other mitigation measures – habitat protection etc.
    - o **(B) Create M. ovi free domestic sheep and goat herds – requires validation in multiple flocks/herds.**
    - o **(B, A) Reduction in herd density ("shotgun approach"); either by sportsmen or agency**
    - o **(B,D,A)** Test pathogen profiles of Domestic Sheep and Goats on public allotments and private lands before they go out on range.
    - o (B) Domestic Goat *Mycoplasma ovipneumoniae* (M. ovi.) Strain as vaccination to existing wild sheep that have a domestic sheep M. ovi. strain – needs validation

TASK #4
Identify Criteria for Candidate Herds for Enhanced Monitoring or Experimental Management Actions

- Agency buy in and support of using the herd for adaptive management trial
- Long-term data available for herd demographics/performance and disease testing including identified herds that fall into the following categories:
  Control Herds (M. ovi negative herds)
    - o Healthy Herds that have been sampled multiple years and show no evidence of M. ovi.
  Herds Vulnerable to M. ovi infection
    - o Healthy Herds not exposed to M. ovi. but are considered at risk from domestic sheep/goats or are adjacent to unhealthy herds and are at risk from disease transmission from these herds .
  Herds that have gone through a disease event or M. ovi has been confirmed in the herd and:
    - o The herds is experiencing a population level response (decreased lamb recruitment or continued adult mortalities directly related to BHS pneumonia complex)
    - o Herds that did not experience a population level response
    - o Herds that did experience a population level response (all age die-off) and are recovering.
- Availability of a control herd if defined in experimental protocol
- Accessibility of herd for capture and population monitoring
- Commitment to long-term monitoring of experiment (including disease and demographic monitoring as identified in experimental design)
- Current data and good understanding of current spatial structure of sub herds
- Ability to secure funding for effort (collaborative funding, preferably including academia)

Task #5
Select sheep herds meeting the identified criteria for participation either in enhanced monitoring or

experimental management actions.

TASK #6
Implement identified enhanced monitoring and experimental, adaptive management actions.

Experimental Trials/Projects - recommended

1) **Augmentation/Reintroduction -** Augmentation of a herd post disease or die-off event with source stock that carries the same M. ovi strain.

   a) Animals from the source herd and the recipient herd have the same strain of M. ovi and both currently have acceptable lamb recruitment or lamb losses are not caused by disease and the recipient herd requires augmentation to achieve critical mass to overcome non-disease related population limiting factors.

   Hypothesis – animals carrying the same M ovi. strain will not introduce a new pathogen since their "immune" status is similar and augmentation should be positive to recipient herd.

   Where: NV in 2015 using 2 separate source herds and UT in 2016/17 and we think AZ conducted in 2015

   Measurable attributes – adults do not develop signs of M ovi. Lamb recruitment improves .
   Experimental control – important: M. ovi. negative source herd is used to augment a M. ovi. negative recipient herd with other herd attributes being the same.

   Success – no disease event in experimental herds

2) **Selective Cull – Test and Cull -** Based on repeated standardized health testing for a suite of pathogens.

   Hypothesis - Pneumonia persists in BHS populations through M. ovi. infection/carriage by super shedders

   Control – Herds with super shedders in place and no selective culling.

   Prediction – The removal of bighorns (ewes especially) carrying M. ovi or super shedders will increase lamb survival and recruitment; M. ovi. prevalence in herd (antigen) will decline as will serological evidence of the pathogen.

   Where – currently 10 locations over 5 years – 6 treatments and 4 controls in Hells Canyon; 1 herd in NV; 2 herds in SD; possibly 3 herds in UT; possibly MT; maybe CO

   Measurable Success- Herd performance improves through decreased lamb disease and increased recruitment.

3) **Total Removal and Repopulation -** Depopulation (complete culling of herd) in conjunction with a repopulation strategy to remove the original source of disease transmission (domestic sheep/goats or other bighorns).

   Hypothesis – Herd performance will improve after total herd cull and repopulation with new bighorn compared to the previous resident herd situation.

   Control – Herds that are underperforming after a disease event, to be monitored with no active

surveillance or management action.

Prediction is the hypothesis

> Source stock for repopulation can be M. ovi. positive or negative but they should be good performing herds and M. ovi. status must be known before reintroduction.

Where – possibly MT, CO – they are doing (Gribbles Park), WA? ND?

Measurable success – Reintroduced herd performs well.

4) <u>**Reduce Herd Density Only Non Selective Cull**</u> - Reduce herd density ("shotgun approach") only without animal selection; either by sportsmen or agency

Hypothesis – Reducing animal density in herds will improve population performance /lamb recruitment in a herd that is currently underperforming post disease or die-off event. OR Reducing herd density alone will avoid disease events.

Control – Herd at high density with no action

Prediction: Reducing animal density may result in:

- reducing the carrying capacity or other density dependent attributes in an M. ovi free herd where you are trying to prevent disease introduction or in infected herd with poor lamb recruitment that you may non-selectively remove the super shedders and decrease M. ovi. prevalence in M. ovi positive herds.
- reduction of ram/ewe dispersal to reduce risk of disease transmission in both M. ovi positive and M. ovi negative herds, and/or

Where ?– CO, WY and UT

Measurable Success – Improvement in herd performance measures and no disease event.

5) <u>**Eliminate M. ovi. from Domestic sheep and goat herds**</u>

Hypothesis – Early weaning and removal of young at 8 weeks or earlier will eliminate M. ovi from domestic sheep or goat herds reducing the risk of M. ovi transmission to wild sheep.

Prediction – Domestic animal population will remain M. ovi. negative; improve lamb weight gains and decrease risk of disease to wild sheep; improve producer buy in.

Where – Dr. Besser research, U of WA/ID sheep flocks? Kevin Hurley will approach Montana State Univ. also; possibility in British Columbia, University of Nevada Reno, WA prison flock?

Measurable Success – Domestic animals remain M. ovi. negative status after 3 consecutive tests and show improved lamb/kid growth rates/survival.

6) <u>**Intensive Monitoring Projects – must have additional input from jurisdictions and academic collaborators**</u>

Hypothesis – Assess identified attributes and determine which play significant roles in the epidemiology of respiratory disease in wild sheep.

Control - not applicable

Prediction – There are specific herd attributes that contribute significantly to herd performance after the introduction of M. ovi.

Where – TBD

Measurable Success – Identification of attributes that can be managed to improve herd performance

Timeline of Next Steps

- Clay and Cox finish minutes and white paper (concise document!) on results of the DMV meeting by late November but not needed before Nov 9 for the WSWG conference call; review by oversight committee or "Adventure Group"
- Teleconference of the DMV Adventure Group to be held in December (Clay to Doodle Poll)
- Present concepts at Winter WAFWA Director's meeting Jan 6 – 10
- Dedicate majority of WSWG meeting in Reno Jan 18 – 20 to DMV

Funding Needs

Multi-state Conservation Grant Program proposal

- AFWA and USFWS cooperatively administer the MSCGP funds and we must submit a National Conservation Needs (NCN) proposal that identifies specific statement of conservation needs to address and desired outcomes from the MSCG project
- Must have NCN completed for the mid-winter WAFWA meeting by January 6 where the directors will select a single NCN to be nominated for funding to AFWA to meet their deadline of February 4.
- If WAFWA did not select the Disease Management Venture as their lone NCN, the Wild Sheep Foundation could nominate our NCN for consideration by AFWA.
- Clay will pursue answers to whether or not it is worth pursuing submitting a NCN
- Will hear back from WSF in November on the Grant In Aid proposal Clay submitted for funding travel for the DMV oversight committee meetings
- Consider a Coordinator / Project Lead position for the DMV
- Identify sources for sampling and testing, radio collars, lab work, and survey efforts to augment state wildlife agencies budgets in implementing DMV
- Follow up with financial analyses (cost/benefit) with human dimensions and outreach communications