Review of the Pronghorn Monitoring Plan in the Pinedale Anticline Project Area Sublette County, Wyoming

Review Committee:

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In April 2010, Matthew Kauffman of the Wyoming Cooperative Fish and Wildlife Research Unit recruited the review committee, and on 26 April 2010 gave the committee its charge by conference call. Dr. Kauffman asked the committee to review the Request for Quote and Work Plan, published by the Bureau of Land Management, for monitoring pronghorn at the Pinedale Anticline Project Area. Dr. Kauffman requested that the committee should write its review to respond to the following two questions:

1. *Are the experimental designs and methods for monitoring described in the Monitoring Plans adequate to detect changes in the criteria identified by the Matrix within a reasonable timeframe?*

2. *If changes in identified criteria (i.e., change in pronghorn survival) do occur in response to energy development on the PAPA, how likely are the monitoring methods described to detect this change and identify when stated thresholds have been met or surpassed?*

Committee members read the RFQ and prepared written responses independently. Committee Chair Byers collected the written comments and prepared a draft review. All committee members then read and approved the review.

Review Summary

1. The Matrix criteria to trigger mitigation are not clearly defined and are inconsistently defined. Unambiguous and independent criteria are needed.

2. The aerial count method is not adequately specified.

3. The ground count method is not adequately specified.

4. Sample sizes for estimating individual survival rates are too low.

5. Survival rates of individual males are not a part of the study, but should be.

6. Fix rates of the GPS collars are too low, and the method by which GPS data would be used to describe migration paths was not specified.

7. There is no plan to describe summer ranges of pronghorn that winter within the PAPA. This is a deficiency, especially if some pronghorn summer within the PAPA, or if travel to some summer ranges may be impeded by development.

In summary, the committee concluded that the absence of unambiguous triggering criteria was especially troubling, and found several fundamental deficiencies in the proposed methods.

A. Critique of the Matrix Criteria

The criteria that would require mitigation for pronghorn, appearing as Appendix A in the RFQ, are as follow:

Criteria	Method	Changes that will be monitored	Specific change requiring mitigation
Change in Anticline antelope numbers	Present WCS antelope study; Present TRC project and use of WGFD data	Change in antelope numbers in any year, or a cumulative change over all years, initially compared to first year of available antelope data	15% decline in any year, or cumulatively over all years, compared to reference area (Sublette antelope herd unit or other, mutually agreeable area)
Size of habitat fragments used		Use by antelope in any year, initially compared to first year of available antelope habitat use data, and a concurrent change in antelope numbers compared to first year of available antelope data	10% decline in habitat availability for one year, and a concurrent 15% change in antelope numbers for that year, compared to reference area (Sublette antelope herd unit or other mutually agreeable area).

The "specific change requiring mitigation" for the "size of habitat fragments used" criterion seems redundant with the "change in Anticline antelope numbers" criterion. If the specific change requiring mitigation is met for size of habitat fragments used then the change requiring mitigation for change in Anticline antelope numbers is automatically met. Both criteria share the 15% change in antelope numbers in a specific year and one criterion is a subset of the other.

There are important implications to this partial overlap in changes requiring mitigation. First, the size of habitat fragments used criterion is more restrictive, by adding the 10% decline in habitat availability qualification. Second, this overlap raises questions about why both criteria, one of which is a subset of the other, are being used. It is possible that the abundance criterion might be met and trigger mitigation and the size of fragments used might not call for mitigation. The size of habitat fragments used criterion is more restrictive because it adds the additional trigger point of changes in habitat availability beyond the same change in Anticline antelope numbers criterion. It is illogical to define a habitat loss criterion, but not allow the habitat criterion to trigger any action unless it is accompanied by a response in numbers that would independently trigger mitigation. At a minimum, the RFQ should clarify the relationship between the two criteria and make it clear why the second (habitat fragment) criterion is defined if it is not allowed to trigger automatic action. A preferable approach would be to specify a true independent mitigation trigger for this criterion.

Criterion one (15% decline in numbers) should be defined more clearly and its logic should be examined. This criterion treats a 15% annual decline and a 15% cumulative decline in the same manner. Obviously, these could imply very different population dynamics. Annual decline of 15% will cut a population in half in four years. Because lag, magnitude and duration of mitigation measures are left undefined in these monitoring and mitigation plans, a clearer plan to avoid dramatic decline should be defined.

The second criterion identifies a "10% decline in habitat availability for one year" as a key feature calling for mitigation. However, habitat availability is not defined in the plan and no objective criteria are provided. The second criterion, as written, would never trigger mitigation on the basis of habitat loss alone. As written, 10% loss of habitat must be accompanied by 15% decline in numbers to trigger mitigation, but a 15% decline in numbers is itself the first criterion.

The second criterion refers to habitat *use* as well as *availability* in the column 'changes that will be monitored', but refers to habitat *availability* in the column

'specific change requiring mitigation'. Use and availability are different things, and the document should be perfectly clear which one is the actual criterion. The document should provide a clear operational definition of 'habitat'. If habitat is not defined in a clear, operational manner, there will inevitably be vagueness in the determination of whether habitat availability has declined by 10%. How will a decline in habitat quality be addressed? That is, habitat 'loss' is usually not a dichotomy, in practice, but a quantitative decline in the value of patches to the species of concern.

Another issue is that a resource selection probability function would help determine how the relative probability of use throughout the area changes over time; however, it is unclear how the resource selection probability function will assess changes in habitat availability. One could argue that habitat throughout the area is available to pronghorn regardless of development activities. What might change is the relative probability of use of these areas. The committee concluded that more direct criteria based on changes in the resource selection probability function (e.g., changes from high use to low use) would be more appropriate (see Sawyer et al. 2006). More information is provided below.

The "10% decline in habitat availability for one year" does not consider the possible cumulative effects of development across years. In some cases, wildlife response to human disturbance might accumulate across a few years and use of resources might be reduced over several years. For example, Sawyer et al. (2006) studying mule deer resource selection in response to development of a natural gas field noted an immediate avoidance of the development area, but also reported greater use of sites farther from well pads over time as the development progressed. Therefore, it might be advisable to consider a cumulative metric because there could be substantial changes in resource selection over time not captured in a single year.

The matrix identifies an effect size for both criteria, but it is a little unclear what is meant by "compared to reference area." Presumably this statement implies change beyond what is observed in the reference area. For example, a 30% decline in pronghorn numbers in reference area and a simultaneous 15% decline in Anticline population could mean that a 45% decline in Anticline population would be necessary to meet change requiring mitigation. Alternatively, the comparison implied might be that a 30% decline in the reference area requires a 34.5% decline (30% + (0.15)(30%) in the Anticline population necessary to meet change requiring mitigation). This issue is important because the ability to detect these different effect sizes is quite different.

The other issue is the representativeness of the reference area. The entire plan and changes requiring mitigation are based on comparisons made with the reference

area. It is assumed that changes in the reference area are representative of changes in the treatment site, in the absence of development. With pronghorn, there are many issues that could result in a violation of this assumption, such as differences in migration and site fidelity to wintering sites at the reference and development area. Although a before and after comparison on the development site would have been ideal, this off-site reference area might still be adequate, but it would be useful to have some assurance that the site is representative. If not, it would be difficult to detect changes in the criteria identified by the matrix within a reasonable time frame. More detail on the matching of attributes between the reference area and the development area should be provided. Why is this area a suitable control? What variables were assessed in selecting this control region?

Further, how does one handle increases in population size? For example, what happens if there is a 20% increase at the reference area in one year and a 5% increase at the development area during that same year? Would that trigger mitigation even though there was an increase in pronghorn numbers at the development area?

B. Aerial Surveys

Are the experimental designs and methods for monitoring described in the Monitoring Plans adequate to detect changes in the criteria identified by the Matrix within a reasonable timeframe?

The committee concluded that further development of the aerial counting method should occur. The RFQ should specify the type of aerial survey (e.g., distance sampling) to be used, and do some power calculations to determine the likelihood of detecting population change of 15% with the proposed sampling intensity. Given the structure of the WMMP, the surveys must have high power to detect a change of this magnitude. Aerial survey sampling intensities sometimes do not. (Particularly if flying at only 300 feet AGL)

The plan identifies use of parallel east/west transects on ½ mile intervals to survey the sites, but it is not clear in the monitoring plan whether there will be any attempt to assess detectability or if they are assuming a total count on the area. Further, there is no discussion of data analysis in the monitoring plan. Appendix E, which describes the aerial survey protocol, does not include key information necessary to estimate detectability, such as sighting distance and sighting angle. The contract with WEST, Inc. indicates they will use a *line transect* sampling method, which implies detectability would be measured.

Consideration of detectability is a critical issue and should be measured, if that is not currently planned. There is a vast literature on line transect (distance) sampling (Burnham et al. 1980, Buckland et al. 2001) and this methodology has been used extensively for pronghorn (Johnson et al. 1991, Pojar et al. 1995, Whittaker et al. 2003, Laake et al. 2008). Further, there is no discussion of basic sampling principles with respect to transect placement. The committee could not ascertain whether the east/west transects would cover the entire area or whether they were selected in some manner (e.g., randomly). If there is some selection involved, care should be taken to consider alternative sampling strategies. For example, stratification could be used to reduce bias and improve precision should a priori information suggest that pronghorn are distributed non-uniformly across the area.

The other advantage of using line transect sampling is the ability to estimate precision, which would facilitate comparisons between sites and across years. Currently there is no discussion of precision of the estimates.

If changes in an identified criteria (i.e., change in pronghorn survival) do occur in response to energy development on the PAPA, how likely are the monitoring methods described to detect this change and identify when stated thresholds have been met or surpassed?

Currently this is not possible given the detail provided in the monitoring plan. We do not know how abundance will be summarized. Also, it is necessary to calculate the variance associated with surveys to adequately assess whether treatment areas have changed relative to reference areas. Further, the accuracy and precision of line transect estimates are directly related to the number of observations (e.g., number of pronghorn groups in this case; Burnham et al. 1980, Buckland et al. 1993). Burnham et al. (1980) recommended a minimum of 40 observations and White et al. (1989) indicated more than 200 observations would be required to achieve a reasonable level of precision (±20% confidence interval). If there are some pilot data or other information available, it would be possible to determine whether detection of these changes is possible.

C. Individual Survivorship

Are the experimental designs and methods for monitoring described in the Monitoring Plans adequate to detect changes in the criteria identified by the Matrix within a reasonable timeframe?

The RFQ proposes to estimate individual survival rates by placing GPS collars on 15 females in the treatment and in the reference area. These sample sizes are insufficient to provide accurate estimates of survival. Although the sample size required will depend on several factors, including method of analysis, 25 animals per area is often considered minimum (Winterstein et al. 2001). Additionally, a known time of death could be approximated from GPS data, but it is unlikely it will be possible to estimate causes of mortality because the duration between death and collar recovery is likely to be substantial given monitoring activities. Additionally, the RFQ makes no mention of estimating the ages of individuals to be radio collared. If the age distribution of collared individuals differs between the reference and treatment areas, survival rate comparisons are inappropriate. Pronghorn can be aged accurately to year 3 by patterns of tooth eruption, and can be placed in reasonable age classes beyond year 3 based upon wear of the cheek teeth (Dow & Wright 1962).

The survival estimates are also inappropriate because they exclude males. In pronghorn, changes in habitat quality that lead to lowered condition at the beginning of winter have a much larger effect on male than female survival (Byers 1997, Dunn & Byers 2009). Thus, the first effect that one could detect in response to a decline in habitat quality would be a change in the adult sex ratio.

The committee concluded that better survival estimates could be obtained by deploying a greater number of conventional VHF radio collars on individual pronghorn of both sexes.

The RFQ did not state the reason for ground counts. Adult sex ratio can be more accurately measured by the aerial counts. Thus, the presumed reason for ground counts is to measure the doe:fawn ratio as an index of recruitment. If this is so, then repeated counts should be made in October, as soon as the animals arrive on winter range. The ability of observers to accurately assign individuals as fawns will decrease in subsequent months. Fawn recruitment is primarily influenced by coyote density on summer range (Byers 2006). This is one reason to describe summer ranges of the PAPA and reference area wintering populations. Recruitment in the PAPA could be higher or lower than in the reference area, not because of habitat differences in wintering area, but because of differences in the quality of the summer area.

If changes in an identified criteria (i.e., change in pronghorn survival) do occur in response to energy development on the PAPA, how likely are the monitoring methods

described to detect this change and identify when stated thresholds have been met or surpassed?

The monitoring methods, as stated in the RFQ, are inadequate. They may overestimate or underestimate true survival rates. Additionally, the methods as proposed will not measure male survival rates. This is inappropriate, because male survival is likely to be more sensitive than female survival to decreases in habitat quality.

D. Habitat Use

> *Are the experimental designs and methods for monitoring described in the Monitoring Plans adequate to detect changes in the criteria identified by the Matrix within a reasonable timeframe?*

As discussed above it is difficult to assess how the resource selection probability function will assess declines in habitat availability. The model could assess changes in the relative probability of *use* throughout the site, but it is unclear how these changes would relate to direct declines in habitat *availability*. Habitat within the area would remain available even if there *are* changes in the relative probability of use. It would be necessary to more explicitly state how changes in the resource selection probability function equate to changes in habitat availability. The RFQ should be more explicit about what constitutes a 10% decline in habitat availability. Additionally, managers might consider alternative metrics to evaluate changes in the resource selection probability function. For example, Sawyer et al. (2006:401) present a table expressing percent changes in mule deer use categories across 3 years in response to natural gas development.

The committee noted that the models intended for use (Sawyer et al. 2006, 2009) could effectively identify changes in resource selection in the area. The criticism here relates to the use of "10% decline in habitat availability for one year" as a key feature calling for mitigation because as written *it is not directly linked to the resource selection model.*

The RFQ mentions that migration routes should be described, but GPS collars that record only 3 fixes per day will be insufficient for this. The collars should be programmed to record fixes at a much greater rate during the migration season. For example, Sawyer et al. (2009) sampled at 2.5 h intervals to describe the migration

paths of mule deer. Reliability of collar drop-off mechanisms should be verified before the collars are deployed. Some drop-off mechanisms are notoriously unreliable.

However, the committee concluded that a description of migration routes, although useful, is somewhat premature. A better sequence of investigation would be to first use a greater number of VHS collars to describe summer ranges of the PAPA winter range animals. Once the proportional use of different summer ranges is known (and whether any pronghorn have summer ranges on the PAPA) then priorities and sample sizes can be set for the migration routes to be described.

If changes in an identified criteria (i.e., change in pronghorn survival) do occur in response to energy development on the PAPA, how likely are the monitoring methods described to detect this change and identify when stated thresholds have been met or surpassed?

The quantitative methods likely are appropriate to detect changes in habitat selection, but inappropriate to detect changes in habitat availability. The methods are not sufficient (in sample size or sampling intervals) to detect changes in migration paths.

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