View Point

The Greater Sage-Grouse Story: Do We Have It Right?

By Matthew A. Cronin

On the Ground

- Greater sage-grouse were found to be threatened or endangered with extinction in a preliminary assessment in 2010, with a final decision on an Endangered Species Act (ESA) listing due in 2015.
- ESA criteria regarding endangered status (in danger of extinction), threatened status (likely to become in danger of extinction), the foreseeable future (in which a species will become in danger of extinction), and a significant portion of a species range (without which a species will be in danger of extinction) are not definitive, rely on predictions, and are all concerned with species extinction, not simply population declines.
- The 2010 ESA determination for sage-grouse relies on observations of declining populations, predictions from models with uncertain assumptions, incomplete population data, and anticipated habitat changes. Prediction of species extinction from this information can be considered speculation, and insufficient for an ESA listing.
- Wildlife management without the encumbrances of the ESA and its associated litigation and regulation can be used to maintain and enhance species that are not in immediate danger of extinction, such as sage-grouse.

Keywords: Greater sage grouse, *Centrocercus urophasianus*, extinction, endangered species act, predictive models.

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Vermeire et al.[1] published a seminal paper in 2004 showing that claims justifying an Endangered Species Act (ESA) listing of the black-tailed prairie dog (*Cynomys ludovicianus*) were not valid. These authors noted that interpretation of data and "selective disregard of literature on the basis of personal values" caused polarized opinions about prairie dog ecology and status, and they advocated for objective evaluation of all applicable science. Much of the argument about prairie dogs was clarified by Vermeire et al.'s presentation of field observations and data, relevant literature, and common sense understanding of prairie dogs by those in the agriculture community.

I replicated the title of Vermeire et al.'s paper, with substitution of greater sage-grouse (*Centrocercus urophasianus*) for prairie dog because both species are widely distributed over some of the same geographic regions and both were considered for ESA listing. Greater sage-grouse were found to be warranted for ESA listing as a threatened or endangered species by the U.S. Fish and Wildlife Service (FWS) in 2010.[2] This ESA listing was precluded by higher priorities, with a final decision due in 2015. Vermeire et al. discussed specific topics related to prairie dog ecology and potential impacts on populations. In this paper, I take a different approach and discuss basic science concepts integral to the ESA and the use of predictions and models as a basis for designation of greater sage-grouse as in danger of extinction. There has been extensive work on greater sage-grouse subsequent to the 2010 ESA finding that will be used in the final 2015 listing decision. I will discuss some of this new information, but I will focus on the basic tenets used to justify the 2010 finding that greater sage-grouse are threatened or endangered with extinction.

Sage-Grouse Species, Subspecies, and Populations

First, we must identify what is or is not endangered with extinction. Because the ESA defines species as "species, subspecies, and (for vertebrates) distinct population segments (DPS)" and subspecies and DPS designations are often subjective,[3,4] this is not a simple question.

In the case of sage-grouse, two species have been designated: greater sage-grouse (*Centrocercus urophasianus*) and Gunnison sage-grouse (*Centrocercus minimus*). These were considered conspecific until recently when Gunnison sage-grouse was described as a separate species.[5] I suggest that adjacent historical ranges, limited genetic differentiation, and lack of definitive evidence of reproductive isolation of Gunnison and greater sage-grouse make this designation uncertain.[6] There is considerable debate over the recent trend of increasing species designations of birds and mammals[7,8] that may be relevant to the Gunnison sage-grouse species

designation. Gunnison sage-grouse have been listed as a threatened species separately from greater sage-grouse.[9] Two subspecies of the greater sage-grouse have been recognized, the eastern (*C. u. urophasianus)* and western (*C. u. phaios*) greater sage-grouse, although these designations have been deemed invalid,[2] as is the case for many other avian subspecies.[4] A DPS of greater sage-grouse is also recognized (Mono Basin in Nevada and California) and has been found to be not warranted for ESA listing.[10]

This leads to an obvious logical dilemma for those making the ESA listing decision in 2015 for the entire species of greater sage-grouse: If a population of greater sage-grouse (Mono Basin) is not endangered with extinction, the entire species cannot be endangered with extinction. In any event, there are presently two species of sage-grouse (Gunnison and Greater) considered threatened or endangered with extinction.

Endangered Species Act Criteria

Under the legal terminology of the ESA,[11] "endangered" means in danger of extinction, and "threatened" means likely to become endangered in the foreseeable future (often considered to be 30 or 100 years) throughout all or a significant portion of the species' range. Endangered (i.e., in danger of extinction) is also described in simple terms as a species "at the brink of extinction now"[12] and presumably means that the species is likely to go extinct without the intercession of ESA actions. The meaning of "extinct" is consistent in *Webster's Ninth New Collegiate Dictionary*: "no longer existing," and in the FWS definition[13]: "An extinct species is a species no longer in existence."

A significant portion of a species' range is:

> *A portion of the range of a species is 'significant' if the species is not currently endangered or threatened throughout all of its range, but the portion's contribution to the viability of the species is so important that, without the members in that portion, the species would be in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range.*[11]

The term "foreseeable future" is not defined, but its designation is left to the discretion of the Secretary of the Interior (who is responsible for FWS), with these qualifications:

> *… the foreseeable future extends only so far as the Secretary can explain reliance on the data to formulate a reliable prediction. What must be avoided is reliance on assumption, speculation, or preconception…The Secretary has broad discretion with respect to what constitutes the foreseeable future….*[14]

These definitions are focused on species extinction, and it is clear that the intent of the ESA is to prevent a species from becoming extinct (i.e., reaching a population number of zero). However, except for "extinction" these ESA terms are scientifically vague and can lead to inconsistent and unpredictable decisions.[15] For example, FWS must decide if a species is in danger of extinction or is likely to become in danger of extinction and what constitutes a significant portion of the range and the foreseeable future with regard to species extinction. These determinations necessarily rely on predictions, the accuracy of which will rely on many factors.

Are Greater Sage-Grouse Endangered with Extinction?

The predictions of greater sage-grouse extinction are based on complex models with uncertain theoretical assumptions regarding genetic variation and fitness and on incomplete data on greater sage-grouse numbers and demographics. Of course, theory and models are integral to science, but they are not always a reflection of reality in nature.

In its determination that the greater sage-grouse is warranted for listing under the ESA,[2] the FWS did a laudable job reviewing and synthesizing an immense amount of literature, including descriptions of widespread greater sage-grouse population declines and their possible causes. However, the essential question is: Is the *entire species* actually threatened or endangered with *extinction*? The FWS has found this to be the case in their finding that the greater sage-grouse was warranted as a threatened or endangered species.[2] Such details as a species being threatened (i.e., not presently endangered but likely to become so) or being endangered in a significant portion of its range (i.e., not the entire range but enough of the range to make the entire species endangered with extinction) do not change the basic tenet that species extinction is the primary concern of an ESA listing. In all categories (endangered, threatened, foreseeable future, and a significant portion of its range), potential extinction of a species is the criterion that makes it appropriate for ESA listing. A species need not be in immediate danger of being reduced to zero, but it must be facing a high likelihood of being so in the foreseeable future to be considered under the ESA.

Extinction is an extreme prediction, considering that greater sage-grouse occupy 56% of their historical range[2] in 11 States and two Canadian Provinces (Fig. 1), and although the number of greater sage-grouse is uncertain it was estimated to be 535,542 birds in 2010 (Table 1). Although there have been recent population declines and problems with impacts to habitat, predation, and other factors as with all wildlife species, I contend that greater sage-grouse are not in immediate danger of extinction. Rather, the 2010 endangered finding was based on predictions of future impacts and habitat loss using demographic models, primarily those of Garton et al.[16] These models have inherent uncertainty and questionable assumptions. Regardless, in the model results many greater sage-grouse populations were actually found not likely to go extinct, and thus it is logical to conclude that the species is not likely to go extinct (as with the Mono Basin population noted above). However, FWS[2] stated:

> *We **anticipate** adverse habitat impacts…and synergism between these impacts (e.g., fire and invasive species expansion) to increase habitat loss; therefore, Garton et al.'s sic (in press)*[16] *likely overestimate the resulting future habitat carrying capacity and population numbers.* (p. 49)
>
> *Based on the current and ongoing habitat issues identified here, their synergistic effects, and their likely continuation in the future, we **conclude** that this threat is significant such that it provides a basis for determining that the species warrants listing under the Act as a threatened or endangered species.* (My emphasis). (p. 52)

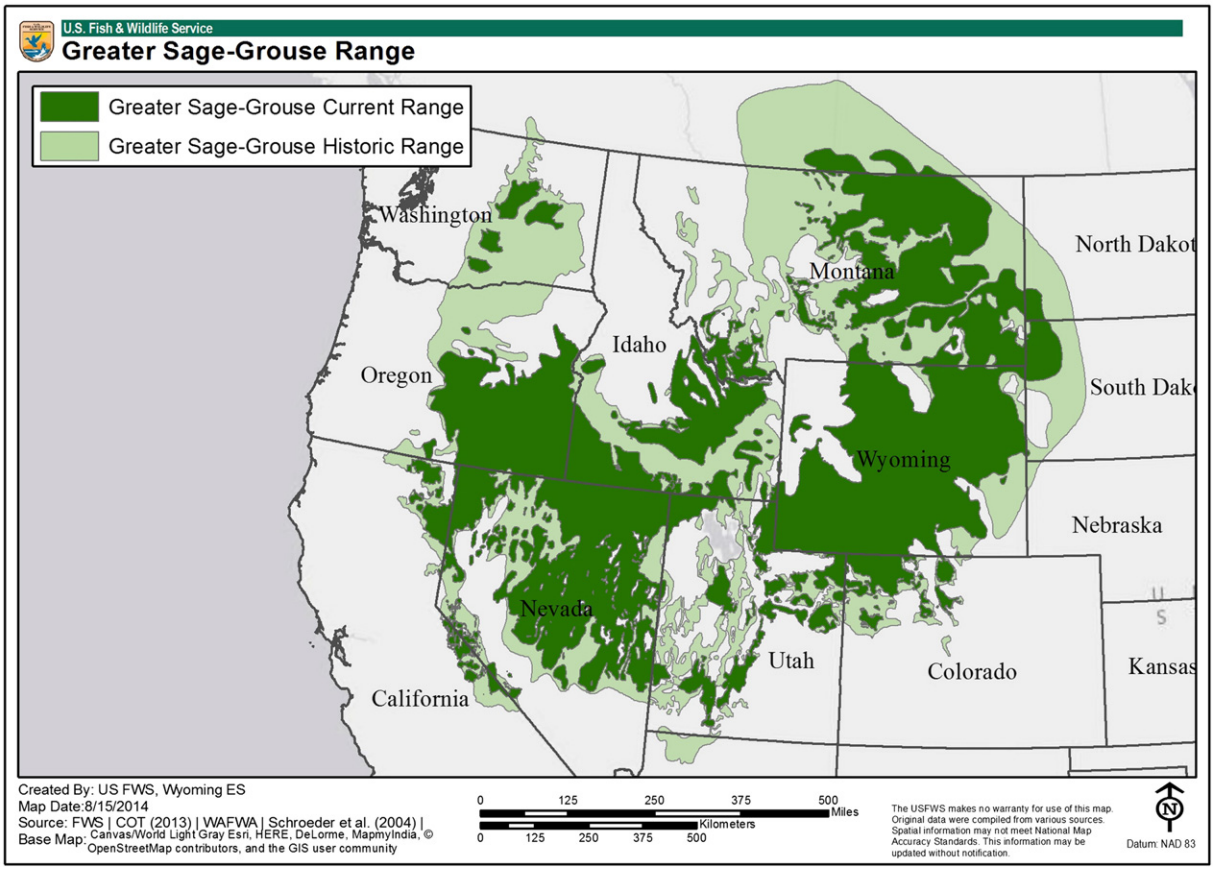

Figure 1. Map of greater sage-grouse current and historic range. (From: http://www.fws.gov/greatersagegrouse/maps/20140815_GRSG_Range.jpg. Accessed 23 June 2015.)

In simple language, this means that FWS concluded that greater sage-grouse are likely to become extinct based on prediction of future impacts to habitat. To reach this finding, the FWS used published model results that did not predict extinction, predicted future impacts and habitat conditions, and then predicted likely extinction of the species. I doubt this analysis would pass scientific peer review. I contend that the prediction of extinction should be treated as a hypothesis (or perhaps speculation or inference, see Discussion), but not as a conclusion.

There is also inconsistency of the population models and the actual status of greater sage-grouse populations. The individual population projection models of Garton et al.[16] used two time frames, a short term of 30 years and a long term of 100 years. The models also considered genetic effective population sizes (N_e) of 50 and 500, following a theoretical (and untested in greater sage-grouse) convention in conservation biology[17,18] that these levels of N_e result in inbreeding, loss of genetic variation, reduction of fitness, and extinction. Although there is experimental evidence of negative effects of inbreeding in gallinaceous birds,[19] there is considerable doubt as to the relevance of these time frames and effective population sizes to extinction risk in wild populations.[20] Therefore, the prediction of extinction is ultimately based on uncertain assumptions regarding loss of genetic variation and fitness.

Table 1. Sage-grouse population estimates based on data from state wildlife agencies

Location	Year estimated	Population
California/Nevada	2004	88,000
Colorado	2008	22,646
Idaho	2007	98,700
Montana	2007	62,320
North Dakota	2007	308
Oregon	2003	40,000
South Dakota	2007	1,500
Utah	2002	12,999
Washington	2003	1,059
Wyoming	2007	207,560
Canada	2006	450
Total		**535,542**

From USDOI (2010).[2]

In contrast, Zink[21] compared actual genetic data with population trends[16] for sage-grouse and found that:

> *…despite habitat reduction and range fragmentation, the greater sage-grouse does not exhibit expected genetic signatures of declining populations… suggesting that the bulk of the range of the greater sage-grouse is not currently in genetic peril.*[21]

Garton et al.[16] also did a metapopulation analysis in which they included consideration of the effects of a maximum dispersal rate of 5% among populations. Dispersal often results in gene flow among populations which can counteract the loss of genetic variation due to genetic drift and inbreeding in small populations. Zink[21] showed that the genetic data for greater sage-grouse are consistent with the occurrence of dispersal among areas, resulting in gene flow that may "counteract local population declines and genetic drift" in much of its range. However, dispersal was apparently not considered in the individual population projections[16] making the assumptions about N_e, inbreeding, and loss of genetic variation even more questionable.

Discussion

Two basic points emerge from my assessment. First, the ESA is concerned with species extinction, and the criteria regarding the timing, spatial extent, and likelihood of extinction are not definite. Second, the 2010 ESA determination for greater sage-grouse relies on predictions from models and anticipated habitat changes that are also not definite. The ESA requires the use of the best available science. Should we consider prediction of extinction of greater sage-grouse as such? This is an important issue because the ESA has serious regulatory and legal ramifications for citizens, agriculture, and the natural resource industries.

As with the black-tailed prairie dog, I think the case for listing the greater sage-grouse falls short of ESA criteria regarding extinction because it is based on predictions for a widely distributed species of more than half a million birds. Greater sage-grouse certainly merit monitoring, and the management practices currently in place need to be maintained or enhanced because there have been population declines and other problems. However, I am specifically considering the issue of prediction of *extinction* which is the focus of the ESA.

Scientists know that predictions are essentially hypotheses which should be tested with observation and measurement, and not presented as conclusions. This is especially the case for predictions from models with questionable assumptions as with the greater sage-grouse. Other recent ESA listings of ringed seals[22] (*Phoca hispida*), bearded seals[23] (*Erignathus barbatus*), walrus[24] (*Odobenus rosmarus*), and polar bears[25] (*Ursus maritimus*) are also based on predictive models and show that the scientific quality of ESA listings has arguably become more speculative than empirical.

The courts sometimes agree with this sentiment. Consider the ESA listing of the Beringia DPS of the bearded seal that was recently vacated and remanded to the National Marine Fisheries Service (NMFS) by the U.S. District Court for Alaska.[26] Like that of the greater sage-grouse, the current number of bearded seals in the Beringia DPS is uncertain, but estimated to be about 155,000 animals,[23] and the NMFS determined that the species was threatened with extinction based on estimated declines over 100 years. However, the Court stated:

> *…the Court concludes that under the circumstances and given the lack of evidence upon which the listing was based, the decision to include the Beringia bearded seals as threatened was arbitrary, capricious and an abuse of discretion.… Under the facts in this case, forecasting more than 50 years into the future is simply too speculative and remote to support a determination that the bearded seal is in danger of becoming extinct.*[26]

In this case the court found prediction to be speculation, which is to be avoided according to the guidance on foreseeable future for the ESA.[14] However, one could also consider prediction to be inference. The distinction between inference and speculation is subtle but important to scientists who might consider inference appropriate and speculation inappropriate for drawing conclusions considering Webster's (*Ninth New Collegiate Dictionary*) definitions:

> *Infer:* to derive as a conclusion from facts or premises.
> *Speculate:* to take to be true on the basis of insufficient evidence.

Clearly, whether predictions of sage grouse extinction are speculation or inference depends on one's view of the sufficiency of data and model results. My view is that predictions of greater sage-grouse extinction from models with uncertain assumptions and anticipation of future impacts is insufficient, and thus speculation, as in the case of bearded seals.

It is perhaps most important to recognize that proactive management without the encumbrances of the ESA can prevent extinctions of species such as greater sage-grouse that are still common and widely distributed. For example, controlling predators[27] and innovative management, such as rearing greater sage-grouse in captivity[28] for demographic or genetic augmentation, can help local populations. Regarding land use and habitat, voluntary incentive programs, such as the conservation reserve program (CRP), can have great success for such species as pheasants (*Phasianus colchicus*).[29] Several states, counties, industries, and other groups in the western United States have already instituted extensive programs for enhanced greater sage-grouse management.[30] Such voluntary programs are more likely to be successful at conserving greater sage-grouse than mandatory regulation and litigation while allowing professional wildlife and land managers to respect multiple-use principles and property rights.

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