



Community Development Department

Planning Division Building Safety Division Environmental Soils Division

P.O. Box 6005 117 NW Lafayette Avenue Bend, Oregon 97708-6005
(541)388-6575 FAX (541)385-1764
<http://www.co.deschutes.or.us/cdd/>

MEMORANDUM

DATE: November 3, 2015
TO: Deschutes County Planning Commission
FROM: Peter Gutowsky, Planning Manager
RE: Greater Sage Grouse Amendments / 247-15-000445-PA / Deliberation

Background

On July 24, 2015, the Oregon Land Conservation and Development Commission (LCDC) adopted rules addressing potential conflicts between "large-scale development" and sage grouse habitat. Oregon Administrative Rule (OAR) 660-023-0115 became effective on August 13, 2015. State law requires Deschutes County to implement them.

The Deschutes County Planning Commission held a public hearing on October 8 in Brothers to consider Comprehensive Plan and Zoning amendments as they pertain to the new OARs and sage grouse conservation. At the conclusion of the meeting, the Commission closed the hearing to oral testimony, but kept the written record open until October 23.

Written Testimony

Staff received two correspondences. Commissioners Powell engaged Jon Jinings, Community Services Specialist with the Department of Land Conservation and Development (DLCD) in an email with questions regarding renewable energy reclamation requirements. The email chain is provided in Attachment A.

Commissioner Kirby asked staff to coordinate with the Oregon Department of Fish and Wildlife (ODFW) to obtain additional rationale for sage grouse hunting, given the conservation efforts being undertaken by affected Oregon counties. Dave Budeau, Upland Game Bird Coordinator with the Oregon Department of Fish and Wildlife (ODFW) responded. The email chain and a Wildlife Society Bulletin article, titled, *Utilizing Hunter Harvest Effort to Survey for Wildlife Disease: A Case Study of West Nile Virus in Greater Sage-Grouse*, are included in Attachment B.

Attachments:

- A. Jinings / Commissioner Powell email
- B. Budeau email chain (includes Wildlife Society Bulletin article)

Peter Gutowsky

From: Nick Lelack
Sent: Monday, October 12, 2015 4:35 PM
To: Peter Gutowsky
Subject: FW: Sage Grouse Provisions and Hearing

Nick Lelack, AICP, Director
Deschutes County Community Development Department
PO Box 6005
117 NW Lafayette
Bend, OR 97708-6005
Office: 541.385.1708 / Cell: 541.639.5585 / Fax: 541.385.1764
www.deschutes.org/cdd

From: Jim Powell [mailto:jhp@bendbroadband.com]
Sent: Monday, October 12, 2015 1:47 PM
To: Jinings, Jon
Cc: Nick Lelack; Edelman, Scott
Subject: Re: Sage Grouse Provisions and Hearing

Thank you for the insight. Since the emails are going to Nick, he can make certain the information makes it into the record for the rest of the Planning Commission to consider.

The county could, I suppose, reinforce meeting the provisions you note in 345-022-0050 and those of DCC 18.52. The question remains as to confirming that in this overlay zone, the requirements that the county has for various activities still must be met even if an activity that does not trigger the "major development" parameter - I just want to make certain that we communicate that we are concerned about impacts, irrespective of size or definitions. So it is nice to get this conversation on the table for discussion.

Enjoyed meeting your son the other night. He seems very self-assured - great to experience him.

Thanks again for your help

On Oct 12, 2015, at 10:32 AM, Jinings, Jon <jon.jinings@state.or.us> wrote:

Commissioner Powell,

First of all, thank you for having me at the meeting in Brothers last week. I enjoyed both the location and the discussion. Peter and Nick were generous with their time and I appreciate that their indulgences but I want to assure you that they would have done fine with out me.

The "retirement" issue has received quite a bit of attention over the years. Many counties have naturally been concerned with the idea of abandoned power generation facilities blighting the landscape.

To my knowledge there are three or four sometimes overlapping ways to guard against such a situation. They sort of go like this:

1. Larger energy projects (105+ MW for Wind, 321+ Acres of Range Land for Photovoltaic Solar) that fall under the jurisdiction of Oregon's Energy Facility Siting Counsel (EFSC) rather than local government

decision makers must abide by OAR 345-022-0050:

345-022-0050

Retirement and Financial Assurance

To issue a site certificate, the Council must find that:

- (1) The site, taking into account mitigation, can be restored adequately to a useful, non-hazardous condition following permanent cessation of construction or operation of the facility.
- (2) The applicant has a reasonable likelihood of obtaining a bond or letter of credit in a form and amount satisfactory to the Council to restore the site to a useful, non-hazardous condition.

2. Energy Facilities that are subject to local review are often subject to conditions of approval that require the developer to post a bond or some other financial instrument that guarantees the capacity to retire the facility. This would be similar to OAR 345-022-0050. Some counties have adopted provisions into their codes. In some instances counties have approved energy facility with no guarantee for retirement.

3. Regardless of the permitting jurisdiction, land owners who lease property to energy developers almost always have a retirement clause in their lease agreement. They don't like the idea of an abandoned facility either. Sometimes solar developers purchase property rather than lease it.

4. I suspect, although I'm not sure and will need to check, that development subject to compensatory mitigation requirements would need to show a plan for retirement.

I hope this helps.

I would like to touch base with my colleagues at the Dept of Energy and ODFW to see how they are inclined to view things. I would also ask Nick what the best way to offer something into the record might be.

Thanks again,

Jon

Jon Jinings | Community Services Specialist
Community Services Division
Oregon Dept. of Land Conservation and Development
Central Regional Solution Center
1011 SW Emkay Drive, Suite 108 | Bend, OR 97702
Cell: (541) 325-6928 | Main: (503) 373-0050 jon.jinings@state.or.us | www.oregon.gov/LCD

From: Jim Powell [jhp@bendbroadband.com]

Sent: Friday, October 09, 2015 4:57 PM

To: Jinings, Jon

Cc: Nick Lelack

Subject: Sage Grouse Provisions and Hearing

Jon

Thank you for your presence and input last evening in Brothers as well as all the work you and others put into drafting the OAR after which the county's code change is patterned. Providing background and information about how the OAR was formulated certainly was helpful to me and, I believe, everyone else in the room.

I do have one additional questions related to what you considered. There have been reports of abandoned windmill farms where investment groups have disappeared and no one assumes responsibility for dismantling the remains. I have not heard this about solar farms to date. You mentioned that reclamation was considered in mining operations, but was it considered for energy projects - and if so, how ? Solar has a lifetime of 20+ years before the panels need reconstitution or replacement. I do not know the lifespan of wind or geothermal facilities. If the power utilities prevail in their current attempts at being able to sidestep the move towards renewables and change the economic

payback equations for these investment companies in renewables, it could be the death knell for even those in operation at the time. Lawyers are too good at finding loopholes in contracts. In addition, unless it has changed, DOGAMI was not very good about enforcing reclamation either. Original CUP for the county for mining could include conditions of limitations in terms of open mines, dust, reclamation, hours, etc. Can the county add considerations such as these to the "large development" or even ones that do not trigger this definition in an effort to meet the intention of preserving and enhancing sage grouse habitat ? I was hoping you could share your thoughts or memory of the discussions around these issues while the record is open.

Thanks for your help. This county and us citizens are fortunate that you are our representative.

Peter Gutowsky

From: David Budeau <david.a.budeau@state.or.us>
Sent: Friday, October 16, 2015 9:09 AM
To: Peter Gutowsky
Cc: Alan Dale
Subject: RE: ODFW / Sage Grouse Text Amendments / Hunting
Attachments: Dusek et al 2014 wsb_472.pdf

Peter,

Chip Dale forwarded your email request regarding information about sage-grouse hunting. Feel free to send all, or part (it may be long), of my response/explanation to Commissioner Kirby.

Understandably, this is not an uncommon question and the answer is not intuitive for some. As with all wildlife, many more sage-grouse are produced each year than will survive through a given year. Most of the annual mortality is natural, i.e. not from hunting, but from disease, predation, accidents, exposure (primarily for chicks), etc. Removing some birds through hunting, will actually result in the remaining birds having a higher probability of survival. Consequently, the population the following spring will be about the same regardless of whether or not hunting took place. How can that be possible? Consider a flock of 10 birds has a little higher chance of being detected by a predator than a flock of 8 birds. Thus the probability of survival is little higher for the flock of 8 birds. Similarly a bird in a flock 10 has the potential of catching a disease or getting parasites from 9 other birds, but a bird in flock of 8 is with only 7 other possible disease vectors, thus reducing its chance of exposure. There may be limiting factors too, like the best roost sites to protect them from weather or predators. If there are few less birds on the landscape there is a little better chance for a bird to get the safest roost sites thus increasing survival. All of these types of mechanisms combined result in the remaining birds having a better chance of survival.

You can think of it like a game of Musical Chairs, but instead of removing chairs, hunting has removed some of the birds, so when the music stops there's a better chance for the remaining birds to find a chair. It is in this way the probability of survival, or finding a chair, increases for the remaining birds. In wildlife biology this is called compensatory mortality and it is based on density dependence. Of course, there is a limit to this compensatory mortality. For species with very high annual natural mortality, like quail, harvest rates can be relatively high and still be compensatory. Also, the longer the time between harvest and the spring breeding population, the greater the chance for reduced natural mortality to compensate for the hunting mortality. As compared to other upland game birds, sage-grouse are longer lived, less productive, and have lower annual natural mortality, so hunting seasons do need to be conservative. Sage-grouse management guidelines (a peer-reviewed science publication) suggests the annual mortality of sage-grouse from hunting should be 10% or less. A more recent scientific paper from banded sage-grouse in Nevada and Colorado found at the highest harvest rate of 11% in the study there was no important impact on the sage-grouse population.

In Oregon, ODFW's self-imposed policy is to harvest no more than 5% of the fall population of sage-grouse in those areas where hunting is allowed (hunting is currently allowed in 10 of 21 Oregon wildlife management units where they are present). This is not a harvest goal, but a level of harvest that should not be exceeded. In practice, we estimate the harvest level is 2- 3% in those areas where the birds are hunted. The sage-grouse hunting season is also held early, in September, to allow more time for effects of compensatory mortality. ODFW carefully manages the number of hunters through a controlled hunt process with a limited number of permits available for each wildlife management unit. The number of permits allowed is based on the population estimate for that year. Each successful applicant can harvest no more than two sage-grouse per season.

The largest threat to sage-grouse is the loss, degradation, and fragmentation of habitat. It is not hunting. If we go back to the Musical Chairs analogy, removing or degrading habitat is like removing the chairs, so when the music stops there

are fewer "chairs" for sage-grouse. Consequently, through habitat loss there are fewer places for the remaining birds to meet all of their life history needs and the population will be reduced.

This is consistent with listing determination the U.S. Fish and Wildlife Service (USFWS) made back in March 2010 when they found that sage-grouse were "warranted, but precluded" under the federal ESA. (The same decision that set in motion all of the hard work over the past 5+ years by state and federal agencies, counties, ranchers, NGOs and others across 11 western states.) In that decision the USFWS wrote "...regulated hunting of sage-grouse does not pose a threat that would lead to the likely endangerment of the species..." and that "...habitat loss appears to be the most important threat to the greater sage-grouse." However, they went on to say that sage-grouse harvest by the states needs to be carefully managed. The USFWS Sage-grouse Fact Sheet which is available on their website https://www.fws.gov/greatersagegrouse/factsheets/GreaterSageGrouseCanon_FINAL.pdf clearly states that hunting is not a threat to the species. Though this fact sheet is still online, it was written prior to the recent determination that sage-grouse do not warrant listing under the federal ESA.

Finally, an important part of the sage-grouse hunting season in Oregon is to collect biological information about sage-grouse that would be difficult and/or expensive to collect otherwise. Oregon hunters have been exceptionally cooperative with this effort. In the past, we have even asked hunters to collect blood samples from birds they harvested for West Nile virus monitoring (see attached scientific publication) and every year we ask hunters to submit one wing from each bird they harvest. By examining the size and progression of feather molt, these wings allow ODFW to determine, age ratios (an index to reproductive success), sex ratios, timing of hatch, and proportion of successfully nesting hens. All of which assists ODFW in the careful management of these birds. Just this year, ODFW in cooperation with Colorado and others published a wildlife technical report summarizing the data collected from these wings. The report can be accessed through ODFW's website at: http://www.dfw.state.or.us/wildlife/research/docs/Fall_Popn_Structure_Sage-grouse_v3182015.pdf

Should you, or any of your Commissioners, have further questions about sage-grouse hunting in Oregon, don't hesitate to contact me.

Thank you,

Dave Budeau
Upland Game Bird Coordinator
Oregon Dept. of Fish and Wildlife
4034 Fairview Industrial Dr. SE
Salem, OR 97302-1142
Ph: (503) 947-6323
e-mail: david.a.budeau@state.or.us

-----Original Message-----

From: Alan Dale [mailto:alan.r.dale@state.or.us]
Sent: Thursday, October 15, 2015 11:45 AM
To: David Budeau (david.a.budeau@state.or.us)
Cc: peter.gutowsky@deschutes.org
Subject: FW: ODFW / Sage Grouse Text Amendments / Hunting

Hi Dave,

Rather than me muddle through what you've already articulated eloquently to our commission, would you kindly respond to Peter's request below.

Thanks in advance

Chip Dale
Klamath and Malheur Watershed Manager
Office 541-388-6363
Cell 541-325-3225

-----Original Message-----

From: Peter Gutowsky [mailto:Peter.Gutowsky@deschutes.org]
Sent: Thursday, October 15, 2015 8:08 AM
To: DALE Alan R (alan.r.dale@state.or.us)
Cc: Nick Lelack
Subject: RE: ODFW / Sage Grouse Text Amendments / Hunting

Chip,

Can you respond to the email below? Maggie Kirby is a Deschutes County Planning Commissioner. Last Thursday at a hearing in Brothers, the Planning Commission received testimony from ranchers expressing their frustration about hunting sage grouse. The written record for the sage grouse text amendments is extended to October 23 so your input is appreciated.

Thanks.

Peter Gutowsky, AICP
Planning Manager
Deschutes County Community Development Department
117 NW Lafayette
Bend, OR 97701
ph# (541)385-1709
fax# (541)385-1764

Web: www.deschutes.org/cdd

-----Original Message-----

From: Maggie Kirby [mailto:kirby.maggie@gmail.com]
Sent: Wednesday, October 14, 2015 7:33 PM
To: Peter Gutowsky
Cc: Nick Lelack
Subject: ODFW

Hi Peter,

I hope you're having a good week. I mentioned last Thursday that it might be useful to the Planning Commission, BOCC and broader public to request a formal response from ODFW for their rationale with corroborating findings for why sage grouse hunting need not be curtailed beyond area affected by recent wildfire whilst Deschutes and other affected counties are preparing to implement plan/ code text amendments to promote healthy sage grouse populations.

Could you please make this request of your ODFW contact?

Thank you in advance.

Regards,
Maggie Kirby



Original Article

Utilizing Hunter Harvest Effort to Survey for Wildlife Disease: A Case Study of West Nile Virus in Greater Sage-Grouse

ROBERT J. DUSEK,¹ *National Wildlife Health Center, United States Geological Survey, 6006 Schroeder Road, Madison, WI 53711, USA*

CHRISTIAN A. HAGEN,² *Oregon Department of Fish and Wildlife, 61374 Parrell Road, Bend, OR 97702, USA*

J. CHRISTIAN FRANSON, *National Wildlife Health Center, United States Geological Survey, 6006 Schroeder Road, Madison, WI 53711, USA*

DAVID A. BUDEAU, *Oregon Department of Fish and Wildlife, 4034 Fairview Industrial Drive SE, Salem, OR 97302, USA*

ERIK K. HOFMEISTER, *National Wildlife Health Center, United States Geological Survey, 6006 Schroeder Road, Madison, WI 53711, USA*

ABSTRACT Greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) are highly susceptible to infection with West Nile virus (WNV), with substantial mortality reported in wild populations and in experimentally infected birds. Although sage-grouse are hunted throughout much of their range, they have also recently been considered for protection under the Endangered Species Act. We used blood samples collected on filter-paper strips during the 2006–2010 Oregon, USA, annual sage-grouse hunt to survey for specific WNV-neutralizing antibodies that indicate a previous infection with WNV. During this period, hunters submitted 1,880 blood samples from sage-grouse they harvested. Samples obtained were proportional for all 12 Oregon sage-grouse hunting units. Laboratory testing of 1,839 samples by the WNV epitope-blocking enzyme-linked immunosorbent assay (bELISA) followed by plaque reduction neutralization test on bELISA-positive samples yielded 19 (1%) and 1 (0.05%) positive samples, respectively. These data provided early baseline information for future comparisons regarding the prevalence of WNV-specific neutralizing antibody in sage-grouse in Oregon. This methodology may provide other states where sage-grouse (or other species) populations are hunted and where WNV constitutes a species conservation concern with a viable option to track the relative prevalence of the virus in populations. © 2014 The Wildlife Society.

KEY WORDS *Centrocercus urophasianus*, filter-paper strip, greater sage-grouse, hunter harvest, Oregon, West Nile virus.

Hunter harvest surveys have been historically used by wildlife management agencies to obtain biological information about game populations (Connelly et al. 2012). With recognition of the importance of wildlife health and potential for zoonotic diseases in wildlife, hunters have also been asked to participate in wildlife health studies regarding the species they harvest (Drew et al. 1992, Schmitt et al. 1997, Dusek et al. 2009).

The importance of hunter surveys in the early detection and spread of wildlife diseases became evident in the 1990s. In California, USA, investigators relied, in part, on serum samples from hunter-killed animals to determine the prevalence of brucellosis in the wildlife species tested (Drew et al. 1992). Hunters can also play an important role in the detection of wildlife disease or disease events through reporting of unique events or observations. Bovine tuberculosis was first detected in white-tailed deer (*Odocoileus*

virginianus) in Michigan, USA, after hunters reported gross lesions observed in the animals they had harvested (Schmitt et al. 1997). Follow-up investigations, again relying on hunter-killed deer, identified the first epidemic occurrence of this disease in wild cervids in North America (Schmitt et al. 1997). In Wisconsin, USA, chronic wasting disease was first reported in 2001 via a hunter-killed white-tailed deer surveillance program set up for that specific purpose (Joly et al. 2003). This finding represented an important range expansion of that disease because it was the first detection in cervids east of the Mississippi River (Joly et al. 2003). More recently avian influenza surveillance programs have relied, in part, on hunter-killed waterfowl from both sport and subsistence hunters as an important resource for obtaining samples (Ip et al. 2008, Dusek et al. 2009).

In 2011 greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) were legally harvested in 10 of 11 states in which they occur (Reese and Connelly 2011). Contemporary sage-grouse hunting seasons vary by timing, length, bag limits, and licensing processes. Sage-grouse hunting in Oregon, USA, is by permit only, and as a result is closely monitored. Harvest was permitted in 12 of 21 wildlife management units, which contain approximately 75% of the state's sage-grouse population, and hunting is regulated to

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¹E-mail: rdusek@usgs.gov

²Present address: Oregon State University, 500 SW Bond Street, Suite 107, Bend, OR 97702, USA

ensure that $\leq 5\%$ of the hunted population is harvested (Hagen 2011).

The current hunting season is 9 days long and occurs in the second week of September. An average (1992–2011) of 1,217 permits has been annually authorized, allowing hunters to take up to 2 birds during the season (D. Budeau, Oregon Department of Fish and Wildlife [ODFW], unpublished data). From 1995 to 2011 the average number of permits issued and sage-grouse reported harvested were 912 permits and 890, respectively (D. Budeau, Oregon Department of Fish and Wildlife, unpublished data). The ODFW monitored sage-grouse harvest by collecting biological data from the wings of hunter-harvested sage-grouse and via phone (1995–2003) and postcard surveys (beginning in 2004) of successful permit applicants (Hagen and Loughin 2008).

West Nile virus (WNV) was first documented in sage-grouse in Montana, USA, in summer 2003 (Naugle et al. 2004). Since then sage-grouse WNV-related mortality has been reported sporadically across the species' range (U.S. Geological Survey [USGS] 2006). Laboratory studies of WNV infection in sage-grouse indicated that the virus caused 100% mortality in experimentally infected birds (Clark et al. 2006). However, one study has reported individual wild sage-grouse that survived WNV infection based on detection of WNV-neutralizing antibody in live birds (Walker et al. 2007).

The transmission season for WNV in sage-grouse has been reported to be approximately mid-May through mid-September (Walker and Naugle 2011). Documented mortality events among sage-grouse due to WNV infection generally have occurred in July and August (Naugle et al. 2004, 2005; USGS 2006). The timing of the transmission season varies and is dependent on environmental conditions that would impact WNV vector mosquito (Culicidae) activity and distribution (Naugle et al. 2005).

In Oregon, a WNV-induced mortality event was detected in sage-grouse in July 2006. This event was accompanied by individual WNV cases and numerous anecdotal reports from ranchers about the disappearance of sage-grouse from their properties (USGS 2006). Because of the potential impact to local sage-grouse populations, the ODFW and the USGS National Wildlife Health Center (NWHC) began a monitoring program to better understand the prevalence of specific WNV-neutralizing antibodies in sage-grouse populations throughout Oregon. The ODFW was interested in using these data to make informed decisions regarding the conservation status of the sage-grouse, because this species is currently listed as a candidate for protection under the Federal Endangered Species Act (U.S. Fish and Wildlife Service 2010).

Using Oregon's permit system for sage-grouse, we instituted a program in 2006 to collect voluntary blood samples using filter-paper strips from hunter-harvested birds for use in a state-wide survey of WNV antibody prevalence in Oregon sage-grouse. We also examined our ability to detect WNV antibody from filter-paper strips when storage conditions and blood absorption deviated from manufac-

turer's recommendations, as might be encountered when stakeholders are engaged in collecting biological samples.

STUDY AREA

We conducted our study across 12 wildlife management units in southeastern Oregon during 2006–2010 (Fig. 1). This region included Baker, Crook, Deschutes, Lake, Harney, and Malheur counties. Samples were collected at elevations that ranged from 1,200 m to 2,500 m where the topography was generally flat to rolling terrain. Vegetation in the region included various sagebrush (*Artemisia* spp.) species co-dominated by perennial bunch-grasses depending upon precipitation and elevation, and western juniper (*Juniperus occidentalis*) occurred at various densities at higher elevations (Johnson and O'Neil 2001). Climate data from the study area included similar mean minimum and maximum temperatures for Malheur and Harney counties (town of Fields = 3.0° and 17.1°C; 1994–2011) and mean total annual precipitation of 23.0 cm (1994–2012) at Fields, Oregon (Harney County; Western Regional Climate Center, <http://www.wrcc.dri.edu/>).

MATERIALS AND METHODS

Field Sampling

Through the Oregon sage-grouse hunt permitting process, we distributed filter-paper strips (Nobuto blood filter strips; Advantec MFS, Inc., Dublin, CA [subsidiary of Toyo Roshikaisha, Ltd., Tokyo, Japan]), sampling instructions, and a postage-paid envelope for submitting wings and Nobuto strips to successful applicants. We sent one Nobuto strip to

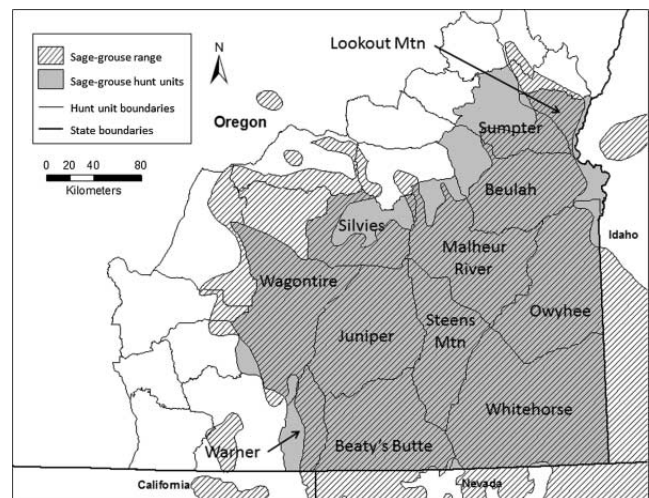


Figure 1. State of Oregon wildlife management units with greater sage-grouse (*Centrocercus urophasianus*) permit-only hunting and current greater sage-grouse distribution detailed. Blood samples to determine presence of specific West Nile virus-neutralizing antibodies were obtained (using filter paper strips) from hunter-killed greater sage-grouse from all 12 greater sage-grouse hunt units during, 2006–2010. Map was created in ArcMap 10.0 (ESRI, Redlands, CA). Hunt unit layer was obtained from the Oregon Department of Fish and Wildlife Natural Resources Information Management Program (<http://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259>). Greater sage-grouse range layer was obtained from <http://sagemap.wr.usgs.gov/GISData.aspx>.

each successful applicant in 2006 because of limited supplies from the distributors. In 2007 through 2010 we sent each successful applicant 2 strips and a visual example of the correct and incorrect application of blood to the Nobuto strip (Fig. 2). From each individual sage-grouse harvested, we asked successful hunters to collect a single blood sample on each strip, air-dry it, and store each strip individually in the coin envelopes provided. Hunters were then asked to mail the collected sample with the corresponding wing to ODFW. Received samples were stored frozen (-20°C) until shipped on frozen ice packs to the NWHC. Wings were later aged and sexed by plumage characteristics at the annual Oregon sage-grouse wing-bee (Crunden 1963).

Sample Quality

Samples we received from hunters were highly variable in the amount of blood absorption on the strip; therefore, we evaluated returned Nobuto strips beginning in 2007 for the extent of blood absorption. We classified blood absorption based on coverage on the Nobuto strip and how thoroughly blood was absorbed. We also noted any inappropriate use of the strip (i.e., absorbing blood on the wrong end). Categories included 0–25%, 26–50%, 51–75%, and 75–100% blood coverage.

Control Samples

To evaluate the accuracy of our blood sampling technique, we compared test results from Nobuto strips prepared with blood obtained from commercially supplied partridge (*Alectoris chukar* \times *A. rufa*) that had been experimentally infected with WNV (as part of a separate study) against those of serum collected from the same birds. We obtained day-old partridge and raised them in a biosafety-level-3 isolation facility until they were 6 weeks of age, then infected them with 10^5 plaque-forming units of a low-passage 1999

American crow (*Corvus brachyrhynchos*) isolate of WNV (NWHC no. 16399-3). The birds were held for an additional 14 days and then euthanized, at which time blood samples were obtained for our study. From up to 7 infected birds, we obtained multiple Nobuto strip samples that were of 3 types: a 100%-absorbed sample per manufacturer's instructions, a 50%-absorbed sample, and a "blot" sample in which the strip was blotted against a blood clot that formed within the sample. These "blot" samples were not fully absorbed through the Nobuto strips and were highly variable regarding the amount of blood absorbed. These 3 types were meant to represent a range of samples obtained from hunters untrained or only briefly trained (by example images) in this method of blood collection. After collection, we randomly assigned samples from each bird to one of 2 groups and stored them either frozen at -20°C or at room temperature (RT; approx. $18\text{--}24^{\circ}\text{C}$). We tested single Nobuto strips for the presence of detectable WNV antibody at 14, 90, and 180 days post-collection (dpc) for those stored at RT, and at 90 and 180 dpc from those stored at -20°C . We also stored serum from each partridge at -20°C and tested it at 14 dpc.

Laboratory Methods

We eluted Nobuto strips per manufacturer's instructions to a dilution of 1:10 except in 2009–2010 when they were eluted to a dilution of 1:20. Dilutions were approximate because all strips were treated similarly, regardless of how much blood was absorbed on the strip. For the detection of anti-WNV antibody, we heat-inactivated eluates at 56°C for 30 min, then screened each sample by the WNV epitope-blocking enzyme-linked immunosorbent assay (bELISA) using WNV/Kunjin NS1 specific monoclonal antibody (MAb 3.112G; Millipore Corp, Billerica, MA; Blitvich et al. 2003).

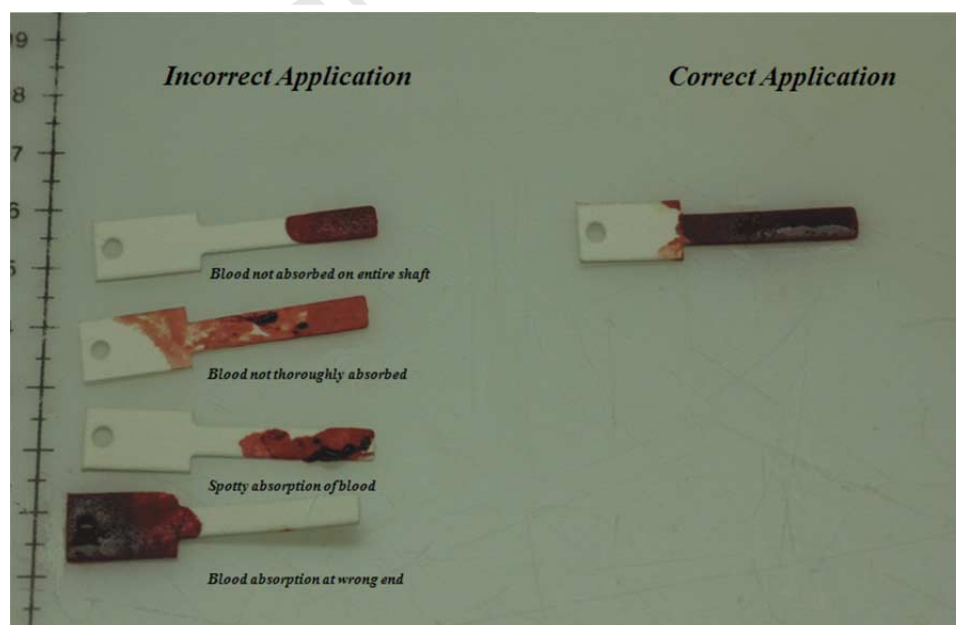


Figure 2. Correct and incorrect applications of blood to Nobuto strips. This image was provided to Oregon, USA, sage-grouse hunters with the Nobuto strips beginning in 2007, so that we could survey from 2006 to 2010 for specific West Nile virus-neutralizing antibodies.

Using this bELISA, all results with $\geq 30\%$ inhibition are considered positive for anti-WNV antibody. We further tested all bELISA samples with $\geq 30\%$ inhibition by plaque reduction neutralization test (PRNT) to confirm the presence of WNV-neutralizing antibodies. We used WNV isolate NWHC 16933-3 diluted in BA-1 (M199 medium with Hank's salts and Tris-HCl, containing 0.008% sodium bicarbonate, 1% bovine serum albumin, 20% fetal bovine serum, 1,000 U/mL penicillin and streptomycin, and 1 mg/mL amphotericin B) so that control wells contained between 60 and 100 plaques (Beaty et al. 1995). We considered sera that exhibited a 90% inhibition of the test dose of virus at a 1:20 dilution as antibody-positive (PRNT₉₀). We further titrated PRNT₉₀-positive samples by serially diluting samples in 2-fold increments until an endpoint titer was determined.

Harvest Survey

We sent postcard harvest surveys to all successful sage-grouse hunt applicants. Based on the response rates, we estimated the number of individuals who actually hunted. We extrapolated the total harvest using response rates (e.g., surveys mailed/response \times response = estimate).

RESULTS

Field Sampling

From 2006 to 2010, we obtained 1,880 Nobuto strip samples from sage-grouse hunters in Oregon and tested 1,839. Samples not tested were inappropriately used or were lost after submission. For the 2008–2010 sage-grouse hunting seasons, 74.6% of wing/Nobuto strip envelopes returned by hunters through the U.S. mail were received within 14 days of the end of the season and 99.6% were received within 90 days of the end of the season.

The bELISA results indicated 19 Nobuto strips were positive for antibodies to WNV and 1 of these samples was confirmed positive by PRNT₉₀ (Titer = 1:80; Table 1). Of the 19 bELISA-positive samples, 14 were female (6 hatch year, 7 after hatch year, 1 unknown age), and 3 were male (2 hatch year, 1 after hatch year). Two birds were of unknown age and sex. No birds that were aged second year were bELISA-positive. The individual that was PRNT₉₀-positive was a hatch year male.

Table 1. Results from Nobuto strip-eluted samples collected by Oregon, USA, greater sage-grouse (*Centrocercus urophasianus*) hunters from 2006 to 2010 and tested by West Nile virus epitope blocking enzyme linked immunosorbent assay (bELISA) and plaque reduction neutralization testing (PRNT) of bELISA-positive samples.

Sample type	Year					Total
	2006	2007	2008	2009	2010	
Nobuto strips tested	307	393	372	380	387	1,839
bELISA-positive	5	10	2	1	1	19
PRNT-positive			1 ^a			1

^a Titer = 1:80.

Hunter Response

From 2006 through 2010, hunter response rate to postcard surveys ranged from 68% to 78%, and an average of 511 (SD = 81) wings was sent in for examination (Table 2). Based on participation of postcard survey respondents, the response rate for submitting Nobuto strips between 2007 and 2010 averaged 71%, (SD = 0.04) and 83% (SD = 0.02) as a proportion of wings returned. However, as a proportion of the average total harvest, the Nobuto response rate was 52% (SD = 0.01; 2007 through 2010). When a single Nobuto strip was provided to each hunter, we obtained samples from 28% of the estimated total harvest; and when 2 strips were provided, we obtained samples from 51% to 54% of the harvested birds (Table 2). We obtained a consistent age and sex distribution among samples that had both a wing and a Nobuto strip submitted (Table 3). We believe the response rates and samples were representative of the distribution of hunted sage-grouse populations in Oregon for the sampling period (Fig. 1 and Table 4).

Sample Quality

We evaluated 1,529 Nobuto strips for sample quality. Sixty-one percent had blood absorbed on >75% of the strip, 26% were 50–75% absorbed, 9% were 25–50% absorbed, and 4% had <25% blood absorption. Of samples with absorption of >75% (the best quality sample) 10 were bELISA-positive with one of those also being PRNT₉₀-positive. Of strips with 50–75% absorption, four were bELISA-positive and no strips categorized as 25–50% blood absorption or <25% blood absorption had positive bELISA results. The remaining 5 Nobuto strips that were bELISA-positive were not evaluated for sample quality.

Control Samples

All 100%-absorbed partridge control samples tested positive for WNV antibody by bELISA and PRNT at all storage time points and conditions except at RT for 180 dpc ($n = 7$ for RT at 14 and 90 dpc, $n = 6$ for all others). For samples stored at RT for 180 dpc, 2 of 6 (33%) tested negative by bELISA and 3 of 6 (50%) tested negative by PRNT₉₀. One of the bELISA-negative samples tested positive by PRNT₉₀.

All of the 50%-absorbed samples tested positive by bELISA and PRNT₉₀ at all storage time points and conditions except when stored at RT for 180 dpc ($n = 6$ for RT at 14 dpc, $n = 5$ for all others). Two of 5 (40%) samples stored at RT for 180 dpc tested negative by bELISA and 4 of 4 (100%) tested negative by PRNT. One sample that tested negative by bELISA with a resulting bELISA value of <10 was not tested by PRNT₉₀.

Seven of 7 (100%) blot samples stored at RT for 14 dpc and stored at -20°C for 90 and 180 dpc were positive by bELISA. Three of 7 (43%) and 6 of 7 (86%) blot samples stored at RT for 90 and 180 dpc tested negative by bELISA. One of 7 (14%) blot samples stored at RT and tested by PRNT₉₀ at 14 dpc was negative, 5 of 7 (71%) tested at 90 dpc were negative, and 1 of 1 tested at 180 dpc was negative. Two of 7 (29%) and 0 of 7 (0%) blot samples stored at -20°C for 90 and 180 dpc were negative, respectively, when tested by

Table 2. Annual response rate of Nobuto strip-sample submission to test for West Nile virus in greater sage-grouse (*Centrocercus urophasianus*) in Oregon, USA, reported as a proportion to postcard survey respondents (actual responses) estimates from postcard survey (estimated from survey), and hunter wing-returns, from 2006 to 2010.

Response category	Year					\bar{x}
	2006 ^a	2007	2008	2009	2010	
Actual responses						
Hunted	611	583	478	569	511	550
Did not hunt	253	186	196	230	149	203
Birds harvested	744	537	502	613	555	590
Bird/hunter	1.22	0.92	1.05	1.08	1.09	1.07
Estimated from survey						
Hunted	894	836	678	727	686	764
Did not hunt	370	267	278	294	200	282
Estimated harvest	1,088	770	712	783	745	820
Hunter response rate	68%	70%	71%	78%	74%	72%
Empirical samples						
Wings received	669	485	443	493	463	511
Nobuto strips received	310	397	381	399	393	376
Nobuto strips tested	307	393	372	380	387	368
Nobuto response rates						
Postcard	0.42	0.74	0.76	0.65	0.71	0.64
Wing returns	0.46	0.82	0.86	0.81	0.85	0.74
Overall	0.28	0.52	0.54	0.51	0.53	0.46

^a A single Nobuto strip was sent to each hunter in 2006, but two were sent in 2007–2010.

Table 3. Age (HY = hatch year, SY = second year, AHY = after hatch year) and gender of hunter-harvested greater sage-grouse (*Centrocercus urophasianus*) sampled for West Nile virus with Nobuto strips in Oregon, USA, 2006–2010.

Year	Females			Males			Unknown	Total
	HY	SY	AHY	HY	SY	AHY		
2006	69	9	66	59	3	74	27	307
2007	52	22	151	45	2	102	19	393
2008	86	14	95	89	0	45	43	372
2009	99	16	78	103	0	67	17	380
2010	101	16	117	72	2	68	11	387
Total	407	77	507	368	7	356	117	1,839

Table 4. Geographic distribution of Nobuto strip samples collected and summary of positive results according to hunt unit and proportion of estimated highest number of greater sage-grouse (*Centrocercus urophasianus*) that could have been harvested between 2006 and 2010.

Hunt unit	Permits available/yr ^a	No. samples tested	Proportion of hunted population sampled ^b (%)	bELISA ^c -positive	PRNT ₉₀ ^d -positive
Sumpter	10	4	4.0		
Lookout mountain	10	12	12.0		
Beulah	150	163	10.9	1	1
Malheur River	105	104	10.4	2	
Owyhee	80	89	11.9	1	
Whitehorse	230	433	19.2	3	
Steens	97	169	21.1	3	
Beaty's Butte	180	284	16.2	2	
Juniper	100	137	13.7	1	
Silvies	20	45	22.5		
Wagontire	58	87	15.8	2	
Warner	150	283	21.8	4	
Unknown		29			
Total	1,190	1,839	16.3	19	1

^a Average based on annual permits authorized from 2006 to 2010.

^b Hunted population is calculated by multiplying the total no. of permits available per year by the no. of birds authorized to take per year (2/permit issued) by the no. of years of this study (5). It represents the hypothetical max. no. of birds that could have been harvested over the period of this study.

^c bELISA—epitope blocking enzyme linked immunosorbent assay.

^d PRNT₉₀—plaque reduction neutralization test. Samples that exhibited a 90% inhibition of the test dose of the virus at a 1:20 dilution were considered positive.

PRNT₉₀. All serum results for experimentally infected partridge were positive by both bELISA and PRNT.

DISCUSSION

We found a low prevalence of WNV antibody in hunter-harvested sage-grouse in Oregon. Walker et al. (2007) also found low prevalence in sage-grouse populations in Montana and Wyoming, where 8 of 167 sage-grouse sampled tested positive for WNV-neutralizing antibody (Walker et al. 2007). High mortality among infected wild birds may explain low rates of antibody detection found by Walker et al. (2007) and in our study (Clark et al. 2006).

Specific WNV-neutralizing antibody develops 7–10 days after infection and can last for >1 year (Langevin et al. 2001, Gibbs et al. 2005). Managers can use the prevalence of antibody in a harvested population as an index of the proportion of animals in that population still alive following the infection that resulted in the development of the antibody tested for (Mueller-Anneling et al. 2000). Although the low prevalence of WNV antibody in our study precluded meaningful comparisons over time and space, our data from 2006 to 2010 provided a baseline, representing an early period of time after WNV was first detected in sage-grouse in 2003, to which future serosurveys can be compared. This methodology could also augment serological testing of live sage-grouse for WNV antibody and would complement other surveys that monitor WNV mortality to better understand long-term impacts of this disease on populations (Walker and Naugle 2011). Implementing surveys such as the one we have described could greatly assist wildlife managers in identifying patterns of disease across broad landscapes. This information can also be useful to the public and veterinary health officials to monitor the spread of disease or may lead to efforts to attempt to eliminate or reduce a disease in a population (Drew et al. 1992, Schmitt et al. 1997, Joly et al. 2003).

Hunter-collected biological samples such as wings have helped with management of sage-grouse in Oregon; these data, in conjunction with other population data such as lek surveys and age-ratios (i.e., from wing data), have enabled wildlife managers in Oregon to efficiently monitor population dynamics, and to establish hunting regulations and bag limits at regional scales (Hagen and Loughin 2008). In our study, hunter-collected blood samples enabled us to test more birds from a broader portion of their range than would have been possible from deploying field crews to live-capture grouse. Other states have successfully used hunter-collected blood samples to identify large-scale trends in other diseases (Mueller-Anneling et al. 2000). Although Nobuto strip sampling has been voluntary in Oregon, hunters have shown an interest in the management of the species and by providing these data have allowed us to gather disease data on >50% of sage-grouse harvested annually, and spatially represented across most of the sage-grouse range in Oregon. The permit-only hunting opportunity facilitated a relatively easy method to expand on the wing collection program to include these blood samples.

Hunter participation in disease surveillance programs can be affected by a number of variables. In our study, post-harvest handling of samples by the hunters may have affected sample quality. Nobuto strips have been previously found to be relatively stable for a period of months for detection of antibodies to avian influenza virus under a variety of storage conditions (Dusek et al. 2011). We found that freezing the strips at -20°C after collection was the preferred method; however, our findings with partridge blood indicated that Nobuto strips could be held up to 90 days at room temperature without compromising our ability to detect WNV antibody by bELISA or PRNT. More than 99% of our sage-grouse samples were submitted to ODFW within 90 days after the season ended and 87% of Nobuto strips were absorbed to 50% or greater suggesting that we would be able to detect positive samples. In addition, most wings received by ODFW had been frozen shortly after harvest. Because Nobuto strips were usually placed in the same envelope with the wing, it is likely that these were frozen also. Upon arrival at the ODFW laboratory in Hines, Oregon (upon receipt with the sage-grouse wings) and at the NWHC (as they arrived at the laboratory for assay), sample handling was controlled. We speculate that any degradation of the samples from being stored at ambient temperatures is likely to cease at the point they were frozen. However, some degradation may have occurred and the bELISA results and PRNT antibody titers we report may be an underestimate of the true prevalence. Perhaps the reason we detected only a single WNV PRNT positive is because this test requires functional antibody to neutralize WNV, and any degradation due to storage conditions may have precluded our ability to detect neutralizing antibody.

Understanding the limitations of using hunters to collect samples for disease detection and the inferences that can be drawn from such data is imperative. However, refining our methodology may enable an expansion of disease monitoring for other harvested wildlife populations in the future. Refinements may include 1) training of hunters on proper sample collection (in our case we used a photograph), 2) detailed instructions regarding field preservation of samples, 3) prompt submission of samples to the state wildlife agency, 4) discarding samples with <50% absorption of blood on the strip and consider discarding those submitted >90 days after collection, and 5) maintaining consistency in sampling period.

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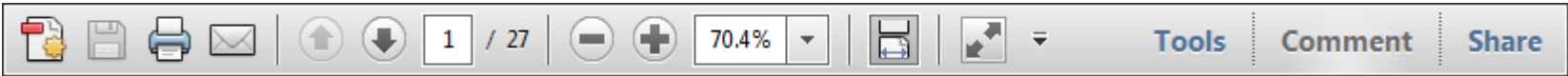
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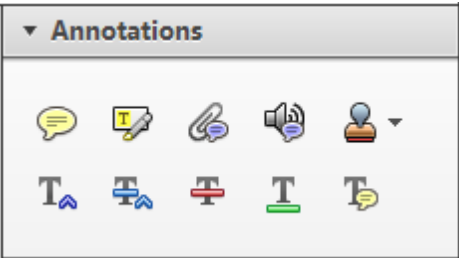
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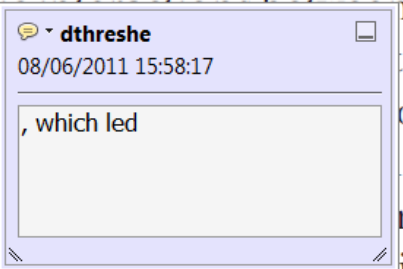


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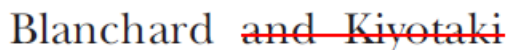


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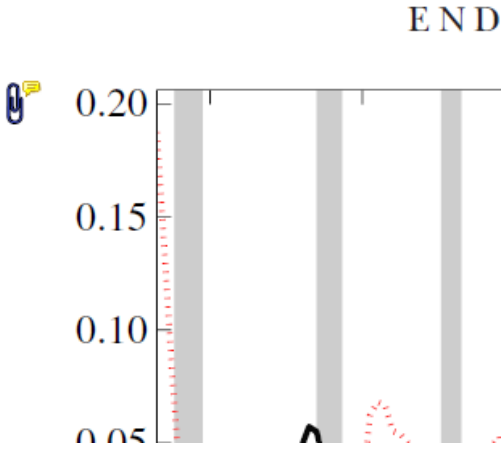
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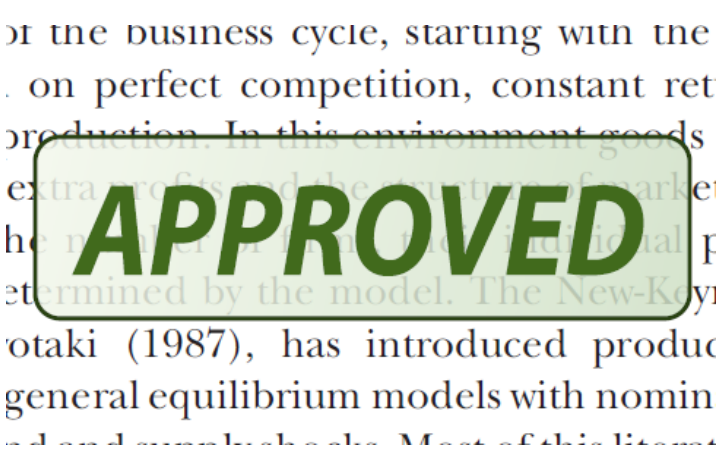
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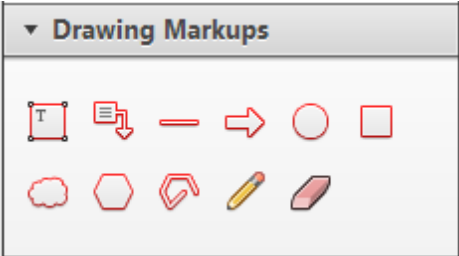
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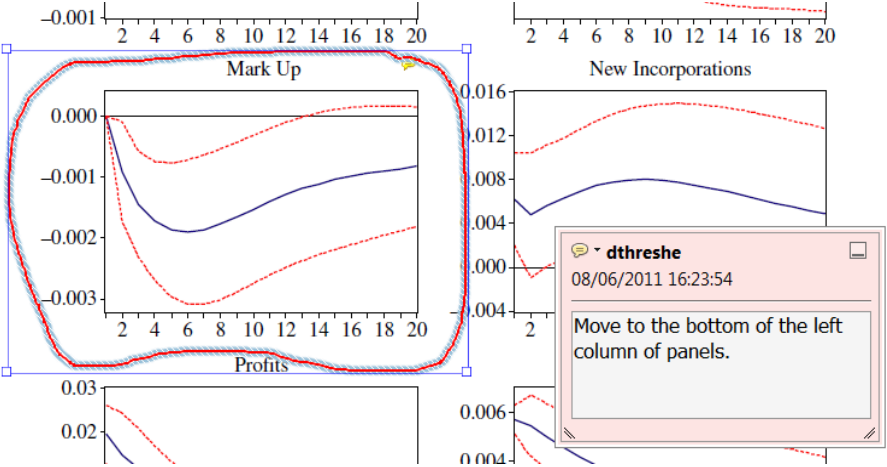
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