From: Dickerson, Kimberly
To: Burgess, Angela
Cc: Amy Nicholas
Subject: Re: GRSG 2015 - contaminants draft chapter
Date: Thursday, March 26, 2015 10:47:58 AM
Attachments: 20150319_Contaminants_AB_kd.docx

Might help if I include the attachment. Sorry.

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On Thu, Mar 26, 2015 at 10:46 AM, Dickerson, Kimberly <kimberly_dickerson@fws.gov> wrote:

> Hi Angela,
>
> Here are the edits for your draft. I have included some comments that I hope will help. I don't have much knowledge on sage-grouse so please feel free to ignore anything that doesn't make sense for sage-grouse world and please let me know if something doesn't make sense for contaminants. I found the chapter interesting. Kim
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> ---
>
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> On Thu, Mar 19, 2015 at 4:37 PM, Burgess, Angela <angela_burgess@fws.gov> wrote:
>
> > Hi Kim,
> > I believe that Amy may have previously asked you if it would be possible for you to review the contaminants chapter that I'm working on for the greater sage-grouse species report. If that's still possible for you, I wanted to pass along my latest draft, which you can find here:
> > https://portal.doi.net/usfws/SG/SpR1/20150319_Contaminants_AB.docx (let me know if you can't access it for some reason).

I'm still working on finishing up the lit. cited section, but I was hoping that you could take a look at the draft. In particular, it would be great to have your input on the Introduction, Threat Description, and Current Impacts sections.

I'm supposed to have a draft to the species leads by April 1, so if there's any chance you could review and get me any edits or comments you have by Friday, March 27, or sooner, I'd really appreciate it!

Please let me know if you have any questions!

Thanks,
Angela

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Chapter 1: CONTAMINANTS

INTRODUCTION

Contaminants, when accidentally or ~~d~~eliberately introduced into the environment, have the potential to pollute water, air, or other resources used by greater sage-grouse (*Centrocurecus urophasianus*; hereafter sage-grouse). Since 2010, sources of contaminants have continued to occur and expand across portions of the sage-grouse range, including oil and gas development, infrastructure, and agriculture. However, while contaminants impact sage-grouse individuals sporadically at a local scale rangewide, it is unlikely that contaminants lead to widespread mortality or declines in sage-grouse populations across management zones.

THREAT DESCRIPTION

Contaminants within the range of the sage-grouse currently include pesticides, garbage, animal/human waste, mining materials, nuclear waste, fire retardants, excess soil sediment, natural gas, oil, and other energy-related materials. These contaminants may be introduced into sage-grouse range during oil and gas development and extraction, mining, agricultural and rangeland management practices, nuclear energy production and research, wildland fire management, and transportation of materials along highways and railroads. Exposure of sage-grouse and their habitat to activities associated with contaminants began following European settler migration, human population expansion, and industrialization of the American west in the 19th and the 20th centuries. Nonrenewable fossil fuel energy development (e.g., petroleum products, coal) and accompanying powerlines, roads, and pipelines began in sage-grouse habitats in the late 1800s (Connelly et al. 2004, p. 7-38). Following the introduction of new chemicals after World War II, pesticide use substantially increased and many were used in sage-grouse habitat to remove sagebrush, other unwanted woody shrubs, and weedy annuals (Baker et al. 1976, p. 166, Connelly et al. 2004, p. 7-28), and to control nuisa~~e~~nce insects (Blus and Connelly 1989, p. 1139). In the 1970s, herbicide application to kill sagebrush was more common in areas with grass understory (e.g., Wyoming), compared to portions of ~~the~~ sage-grouse range without much grass (e.g.,

Comment [KD1]: I felt that the first two sentences were somewhat redundant so I took the liberty of suggesting an alternative (take it or leave it): Contaminants with the range of the sg include pesticides, mining and energy-related materials, garbage, animal/human waste, amd fire retardants. Such contaminants may be introduced during agricultural and rangeland management practices, oil, gas, coal and nuclear research, development, and production, transportation of materials along highways and railroags, and wildlife fire management.

Comment [KD2]: What is excessive soil sediment referring to? Excessive dust, salts, nutrient from agriculture?

Nevada) (Vale 1974, p. 276). Since the late 1800s, the specific types of contaminants associated with these activities have changed ~~over time,~~but sources of~~or~~ contaminants across the range of the sage-grouse have remained consistent. However, ~~regulation of air and water pollution and~~ the establishment of national air and water quality standards (Lewis 1988, entire) has likely influenced the level of contaminants in the environment and their impacts on wildlife.

Comment [KD3]: This sentence doesn't make sense as to why there was an difference and how it is different from herbicide use after WWII? Perhaps rewording if herbicide use increased further after WWII and why this fact is important; otherwise may want to delete.

Comment [KD4]: Reference needed in citation

CURRENT IMPACTS

Mechanism

Direct exposure to contaminants may impact health and survival of sage-grouse. Mortality of sage-grouse can occur if they enter oil and gas wastewater pits. Exposure to spills or leaks of contaminats associated with the numerous gas and oil pipelines occurring within the occupied range of the species may lead to mortalities or morbidity to sage-grouse. Similarly, given the extensive network of highways and railroad lines that occur throughout the range of the sage-grouse (see Chapter X for more information on infrastructure), there is some potential for direct exposure of sage-grouse to contaminants resulting from spills or leaks of hazardous materials being conveyed along these transportation corridors. Radionuclides (radioactive atoms) from both oil and gas activities and uranium mining, if intercepted by wildlife, can cause internal damage from radioactive decay (Kennedy et al. 1990, p. 10). Exposure of sage-grouse to radionuclides has been documented at the the Department of Energy's (DOE)~~'s~~ Idaho National Engineering Laboratory in eastern Idaho. Mining may directly expose sage-grouse to ~~toxic~~ elevated levels of metals~~,~~ or other minerals, and/or contaminated fluids used in the extraction. Toxic concentrations of metals or chemicals, used in mining, have been found in birds occurring near mining operations (Pristos and Ma 1997, p. 203; Beyer et al. 2004, p. 116; Hansen et al. 2011, p. 593). Direct exposure to pesticides may have lethal or sublethal effects to sage-grouse, depending on the pesticide, level of exposure, and area sprayed. Insecticides have been documented to cause mortality (Blus et al. 1989, p. 1142; Blus and Connelly 1998, p. 23; Christiansen and Tate 2011, p. 20), abnormal behavior ~~(~~(Dahlen and Haugen 1954, p. 477; McEwen and Brown 1966, p. 609; Blus et al. 1989, p. 1141), and increased

risk of predation or collision with vehicles and mowing equipment (Christiansen and Tate 2011, p. 20) in sage-grouse. Within sage-grouse habitat, high-density oil and gas development, combustion engine emissions, and dust from roads and wind erosion produce airborne pollutants that may reach or exceed quality standards in localized areas for short periods of time (BLM 2008~~d~~, pp. 4-74, 4-82 to 4-88; Helmig et al. 2014, p. 4710, Macey et al. 2014, p. 15). Birds may be sensitive to and have negative health consequences when directly exposed to air contaminants (Cuesta et al. 2005, p. 776, Olsgard 2007, p. iv, Olsgard et al. 2008, p. 1105). Direct exposure to contaminants may lead to mortality or impact health of individual sage-grouse.

Sage-grouse may be indirectly ~~impacted~~ affected when contaminants are introduced into their habitat. Spills, leaks, or purposeful application of hazardous substances can result in vegetation die-off, reduction of insects important in the diet of sage-grouse, and loss of suitable water sources. Herbicide applications can kill sagebrush and forbs important as food sources for sage-grouse (Carr 1968 as cited in Call and Maser 1985, p. 14). Loss of vegetation cover can also result in increased soil erosion and subsequent reduced soil depths, decreased water infiltration, and reduced water storage capacity (Miller *et al.* 2011, p. 174), further degrading vegetation and riparian areas used by sage-grouse. Use of insecticides, including neonicitinoids, may reduce insect populations and indirectly expose insect-eating birds to insecticides (Mineau and Palmer 2013, p. 20, Gibbons et al. 2015, p. 105). Pesticide treatment for grasshopper ~~removal~~ control appear~~t~~ed to affect nestling development and resulted in mortality for 50–100 percent of songbird and corvid nestlings, depending on the chemical used (Eng 1952; pp. 332, 334). Partridge chicks (*Perdix perdix*) had high starvation rates resulting from reduced food supply when ~~during the use of~~ pesticides were applied (Rands 1985, p. 56). Wildlife may be indirectly exposed to pesticidal proteins occurring in genetically-modified organism (GMOs) through bioaccumulation, if diets include insects that consume GMOs (Wolfenbarger *et al.*2000, p. 2089). Human development potentially exposes sage-grouse to pathogens introduced from septic systems and waste disposal (Moore and Mills 1977, pp. 114-116, 135). ~~Water contamination in sage-grouse habitat could occur during from leaching of waste rock and overburden and nutrients from blasting chemicals and fertilizer used during mining operations~~ Mining operations can contribute contamination to water sources in sage-grouse habitat as a

Comment [KD5]: There is almost no information on birds except these two studies by Olsgard. I did include a pigeon/air quality in case you want to use it. We are hoping to get a study funded through the GNLCC to investigate air quality impacts on birds from oil and gas developments in western WY.

Comment [AB6]: Kim – do you know of any other studies about air quality and impacts to birds (or even better, sage-grouse)?

Comment [KD7]: I think a brief statement on how this negatively affect wildlife is important – does it affect wildlife itself or its food source ? Since GMOs are primarily an agricultural issue, will this really affect sg or is it mostly a reduction in insect abundance?

Comment [KD8]: Again I think that a brief statement as to what effects the pathogens cause in the birds would help clarify – do they get a disease from a certin virus, infection from bacteria, ingest waste so that they are esposed to human pharmaceuticals or personal care products that can affect their reproductive ability, etc.?

result of blasting chemicals (ammonium nitrate, fuel oil), fertilizers, or metal leachate from waste rock or overburden (~~Earth Island Journal 2013, entire~~; Moore and Mills 1977, pp. 115, 133, Adams and Pickett 1998, p. 486, Ramirez and Rogers 2002, p. 434-435). Chemicals used to control wildland fires within sagebrush ecosystems may reduce species richness of vegetation for short time periods (Larson et al. 1999, p. 115). Air pollution can impact plant and insect health and abundance (Alstad and Edmunds, Jr. ~~et al.~~ 1982, p. 369, University of Illinois 2002, pp. 1–2). Contamination of sage-grouse habitat may increase habitat fragmination or displace sage-grouse to less optimal habitat.

Comment [KD9]: Are fertilizers used in the reclamation of mined areas or is this referring to mining of fertilizer substances such as phosphorus? I think clarifying this would help because fertilizer contamination is typically more of a problem from agriculture – I don't have a specific reference on this for mining.

Comment [KD10]: I am not sure this is a good reference as it isn't associated with an academic journal.

Comment [KD11]: But how does this indirectly affect sg? Adding something to the end of this sentence explaining why would help clarify. i.e. …, thereby reducing cover for the birds (or whatever the impact is). This would be the same for the next sentence - perhaps you can somehow combine these two sentences.

Comment [KD12]: From what? Otherwise this is too general.

Results of impact

Direct exposure to contaminants may decrease sage-grouse survival and fitness while indirect exposure ~~may~~ to contaminants may limit sage-grouse food, water, and cover, thereby decreasing breeding, nesting, brood success, and adult survival. However, current literature on contaminant exposure to sage-grouse is minimal. For example, mortality of sage-grouse occurring as a result of oil and gas operations is difficult to quantify due to a lack of monitoring.~~The extent to which such mortality to greater sage-grouse is occurring related to oil and gas operations is extremely difficult to quantify due to difficulties in retrieving and identifying oiled birds and lack of monitoring.~~ A single sage-grouse carcass was found covered with oil ~~and dead~~ in a wastewater pit associated with field development in 2006 but typically it is very difficult to identify oiled birds~~; the site was in violation of legal requirements for screening the pit~~ (Domenici 2008, pers. comm.). We expect that the number of sage-grouse occurring in the immediate vicinity of such wastewater pits to~~would~~ be small because of ~~due to~~ the typically intense human activity in these areas, the lack of cover around the pits, and that sage-grouse typically do not require free water. Most bird mortalities recorded in association with wastewater pits are water-dependent species (e.g., waterfowl)~~, whereas dead ground-dwelling birds (such as the greater sage-grouse) are rarely found at such sites~~ (Domenici 2008, pers. comm.); ~~. H~~however, if the wastewater pits are not appropriately screened, sage-grouse could ~~may have access to them and could ingest water and/or~~ become oiled while pursuing insects or drinking water. If these birds ~~then~~ return to sagebrush cover and die, their carcasses are unlikely to be found as only the pits are surveyed. Furthermore, female birds returning to their nests can

Comment [AB13]: In the process of updating with LE.

transfer the oil on their feathers to their eggs affecting embryo survival (Albers 1978, p. 625-628, Hoffman and Gay 1981, p. 778-782).

We found no documented occurrences of direct mortality to sage-grouse from chemical~~ontaminant~~ spills. W~~, and w~~e do not expect they are a significant source of mortality~~-~~ at a population level because such ~~these types of~~ spills occur infrequently and typically impact small areas relative to the range of the species. Sage-grouse do not require water other than what they obtain from plant resources (Schroeder et al. 1999, p. 6); therefore, local water quality deterioration is not expected to have population-level impacts. Degradation of riparian areas from oil and gas extraction, mining operations, or human development could result in a loss of brood habitat, but we have not found documented occurances of contamination of riparian areas leading to mortality of sage-grouse.

Although radionuclides were present in greater sage-grouse at DOE's Idaho National Engineery Laboratory in eastern Idaho, there were no apparent harmful effects to the population (Connelly and Markham 1983, pp. 175176). There is one site in Washington, within the range formerly occupied by the species (Nuclear Energy Institute 2014), and development of a new nuclear power plant facility Idaho is underway (Culverwell 2015) in MZ IV. ~~At this potential new facility and any other future facilities developed for nuclear power, if all~~ With current provisions regulating nuclear energy development, ~~are followed,~~ it is unlikely that there will be population impacts to sage-grouse as a result of radionuclides or any other nuclear products from new and future facilities.

Impacts from pesticides may be underestimated if sage-grouse disperse from agricultural areas after exposure. The actual footprint of effects from cropland spraying cannot be estimated~~,~~ because the distances traveled to irrigated and sprayed fields is unknown (Knick et al. 2011, p. 17). Methamidophos and dimethoate, which were associated with 63 mortalities of sage-grouse in 1986 (Blus et al. 1989, p. 1142; Blus and Connelly 1998, p. 23), remain registered for use in the United States (Christiansen and Tate 2011, p. 21), but we found no further records of sage-grouse mortalities from their use. Insecticides potentially affect sage-grouse over broad

Comment [KD14]: Is there contamination still here (Hanford?) and/or downwind from sg area? Is this site and the new facility in ID important today because the WA site may be recolonized by sg and the ID is near sg? If not, I would eliminate reference to these sites and keep the last sentence

Comment [KD15]: MZ IV - this probably refers to something in the sg work that I don't understand?

Comment [KD16]: This is the first time agrixulture areas has been mentioned other than pesticide use for rangelands in the beginning. If sg are in areas where there are crops then I would suggest making reference to pesticide use on crops in the above section(s).

Comment [AB17]: Need to update page number

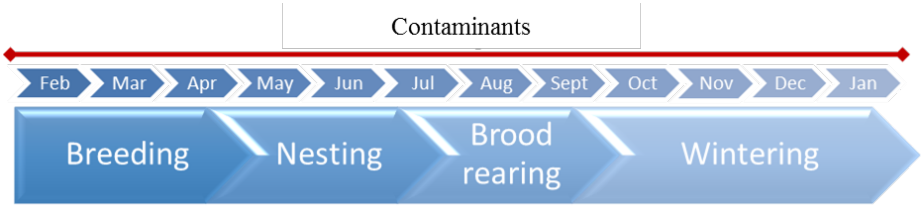
regions, but no rangewide estimates of mortality are available. Insecticides used by the Animal and Plant Health Inspection Service (APHIS) to suppress grasshoppers in the Rangeland Grasshopper and Mormon Cricket Suppression Program were not expected to be directly or indirectly toxic to sage-grouse (APHIS 2002, p.10). Much of the research related to pesticides that had either lethal or sublethal effects on sage-grouse was conducted on pesticides that have been banned or ~~have~~ had their use further restricted for more than 20 years due to their toxic effects on the environment (e.g., toxaphene or chordane bait for grasshopper control, strychnine bate for above ground mammal control, dieldrin for crop pests). We currently do not have any information to show that ~~the~~ banned pesticides are presently having negative impacts to sage-grouse populations through either illegal use or residues in the environment. Although a reduction in insect population levels resulting from insecticide application can potentially affect nesting sage-grouse females and chicks (Willis et al. 1993, p. 40; Schroeder et al. 1999, p. 16), we have no information as to whether insecticides are impacting survivorship or productivity of the greater sage-grouse. Treatments for grasshopper suppression done by APHIS would typically not reduce the number of grasshoppers below levels that are present in non-outbreak years (APHIS 2002, p.10). A comparison of applied levels of herbicides with toxicity studies of grouse, chickens, and other gamebirds (Carr 1968, as cited in Call and Maser 1985, p. 15) concluded that herbicides applied at recommended rates should not result in sage-grouse poisonings. However, sage-grouse have avoided areas sprayed by the herbicides due to a reduction of favored food plants (Martin 1970, pp. 316, 320).

Presumably air emissions from oil and gas development are quickly dispersed in the windy, open conditions of sagebrush habitats (Moore and Mills 1977, p. 109), minimizing the potential direct effects on wildlife. We were unable to find any documented occurrences of regarding the effects to sage-grouse of gaseous emissions produced by oil and gas development.

Timing

Impacts to sage-grouse from contaminants may occur throughout the year. Chemical s~~S~~pills ~~of contaminants~~ are sporadic and typically unpredictable. Pesticide use ~~is~~ primarily occurs during the summer

months, though depending on the target species and specific pesticide, they may be used in or near sage-grouse habitat year around and throughout the lifespan of the sage-grouse.



Location and extent

Direct mortality from a sage-grouse entering and becoming trapped in a wastewater pit would be most likely threat in MZ I and II, as the~~e~~se zones are where most of the oil and gas developments occur~~s~~ in relation to occupied sage-grouse habitat. Additionally, it is likely that impacts from spills associated with oil and gas developments would be most frequent in these areas (see Chapter X for more information on oil and gas development). Impacts from mining-related contaminants would be most likely within MZ I, II, III, and IV, ~~where mining is most prevalent~~ (see Chapter X for more information on mining). Contaminants related to human development would ~~likely~~ occur near ~~to~~ human population centers, mostly~~. Urban and exurban development occurs at the highest levels~~ in MZ II, V, and VI. The primary agricultural regions within historical sagebrush habitat occur in MZ I (19 percent of the total area) and VI (32 percent of the total area) (Knick et al. 2011, p. 209), though these activities, and therefore the contaminants associated with them (including pesticides), occur throughout the range (see Chapters X and X for more information on exurban development and agricultural activities, respectively). Contamination associated with nuclear energy is likely limited to facilities in Idaho (DOE's Idaho National Engineering Laboratory in eastern Idaho and one site in the range formerly occupied by the species, and locations where future nuclear energy facilities are located.

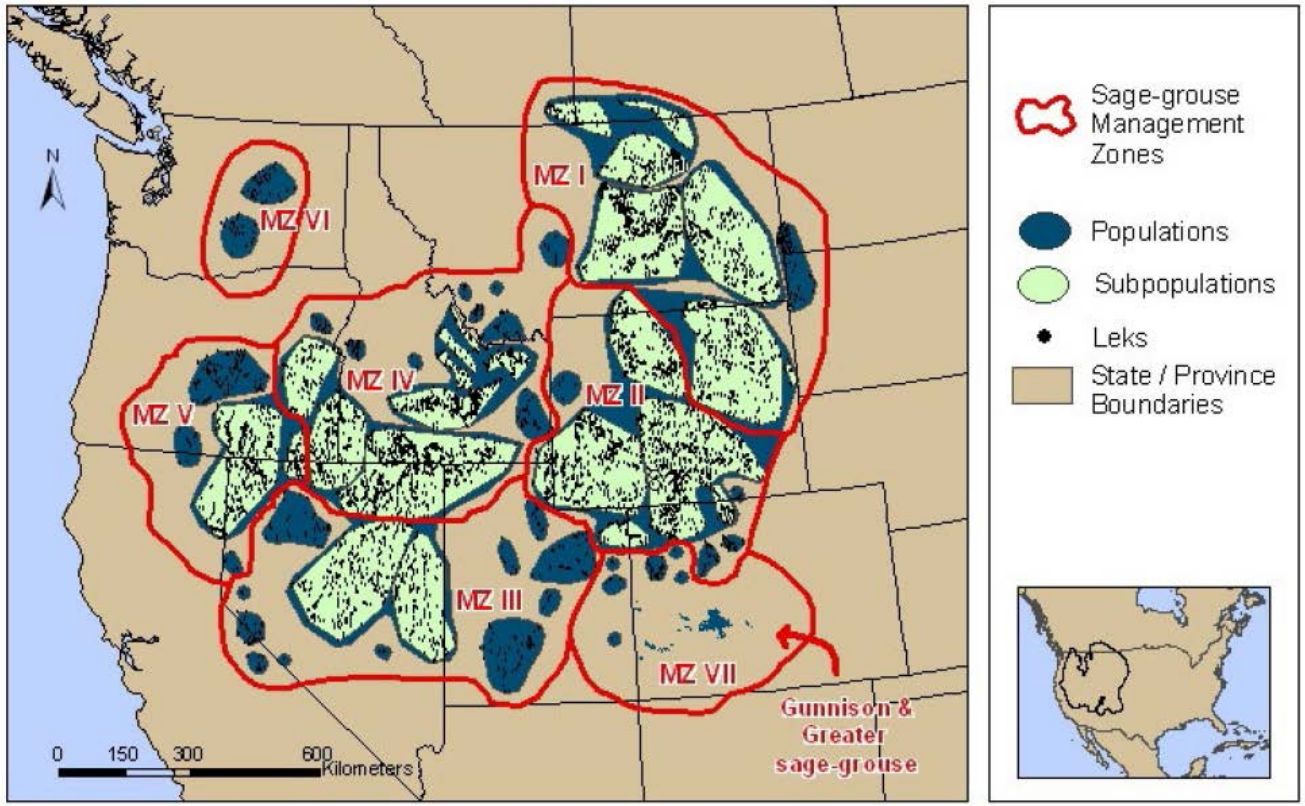
Table 1: List of impacts by management zone.

Management Zone	Timing of Impacts (Season)	Immediacy of Impacts	Severity of Impacts	Extent of Impacts	Resource or Life stage impacted	Notes

Comment [AB18]: This table is still being worked on/discussed, but because of a lack of complete data for contaminants, it will likely be difficult to delineate by management zone, other than discuss what types of activities are occurring that may lead to contamination…

Example	Spring (or all the time, etc.)	Happening right now (or planned)	Direct mortality (or habitat destruction, etc.)	Impacting X% of occupied range by MZ	Lekking adults, broods	This is an example…
1						
2						
3						
4						
5						
6						
7						

Map Showing Current Threats (this is "Map 2" that the GIS team is working on; ***we will not have this map for all chapters****)*



MZ I - Great Plains MZ
MZ II - Wyoming Basins MZ
MZ III - Southern Great Basin MZ
MZ IV - Snake River Plain MZ
MZ V - Northern Great Basin MZ
MZ VI - Columbia Basin MZ
MZ VII - Colorado Plateau MZ

Comment [AB19]: Still working with Ed for potential GIS maps, but for this chapter, I'm guessing that it will be more reliant on other chapters about things that could be sources for contaminants (oil and gas, ag, human development, infrastructure…)

Compounded effects

The compounding effects will be discussed in greater detail in the Compounded Effects chapter. In brief, the following impacts are likely to interact with the threat described in this chapter.

- Infrastructure (pipelines, roadways, railroads) – Failures in infrastructure such as pipelines may increase threats of exposure of contaminants to sage grouse. Roadways and railways may be used to transport chemicals~~contaminants~~. Invasive plants may become established during the construction of various infrastructure projects, which may require use of pesticides for~~to~~ control. Additionally, pipeline and electric transmission line ROWs frequently require vegetation management, which also may require the ~~be done through~~ use of pesticides.
- Mining – mined substances and chemicals used in mining may lead to contamination.
- Nonrenewable Energy Development – oil, gas, and other chemicals associated with the production and development of nonrenewable energy may be toxic to sage-grouse and negatively impact sage-grouse habitat.
- Renewable Energy Development – Renewable energy development (wind turbines, solar panels) frequently require vegetation management, which may require ~~be done through~~ the use of pesticides.
- Rangeland Management – Management of livestock and ranching activities could expose sage-grouse to chemicals~~be related to contaminants threats~~. Pesticides are frequently used in agricultural and rangeland activities to reduce unwanted species. The Rangeland Grasshopper and Mormon Cricket Suppression Control Program (APHIS 2002, entire) may include the use of three approved insecticides (carbaryl, diflubenzuron, and malathion).

- Invasive Plants – Control of invasive plants by land managers may require use of pesticides. This management action may be done to benefit sage-grouse within occupied habitat.
- Recreation – Areas used by humans for recreational activities (hiking trails, OHV trails, camping areas) may have increased use of pesticides for weed control.
- Fire – use and dispersal of fire retardants in sage-grouse habitat may impact vegetation composition.

PROJECTED FUTURE IMPACTS

a. Timescale for Projecting this Threat

Comment [AB20]: Somewhat of an issue figuring out what to say for this…as it's based on the activities that are associated with contaminants. Because we have such a wide variety of answers/timescales, it looks a bit strange all put next to each other.

The timescale for projecting impacts associated with contaminants would be the same as the timescale ~~associated with~~ of the ~~associated~~ activities that are the primary sources of contaminants. We anticipate that agricultural conversion will contribute to the modification (i.e., compounded effects from pesticides) of sage-grouse habitat and range for the foreseeable future. We anticipate that urban and exurban development will contribute to ~~the~~ present and ~~threatened~~ future habitat destruction (i.e., direct habitat loss) and ~~,~~ modification (i.e., compounded effects from associated pesticides, garbage, human and pet waste) ~~for the foreseeable future~~. We anticipate invasive plants and associated fires will occur~~be~~ on the landscape for the next 100 years or longer. The effects of oil and gas development are likely to continue for decades, even with the current protective or mitigative measures in place. It is anticipated that mining activities within the range of the sage-grouse will continue indefinitely.

b. Likelihood of future impacts

Given the level of activities associated with contaminants sources across the range of ~~the~~ sage-grouse, it is highly likely that future impacts ~~from contaminants~~ will continue ~~to occur~~

~~across the range~~.

c. Anticipated changes from present

Future impacts from contaminants compared to the present is directly associated with changes in the activities associated with contaminants. It is likely that sources of contaminants will increase across the sage-grouse range as the human population increases. Technological advances in industrial operations may decrease the risk of unintended releases of contaminants in the environment or allow for easier, faster clean-up response to such releases. Additional research and application techniques for pesticides may allow for more targeted application, potentially leading fewer impacts on sage-grouse. However, based on the current state of activities within the sage-grouse range, it is likely that contaminants will stay at current levels or increase in the future.

THREAT AMELIORATION

Comment [AB21]: Waiting to see what conservation actions may be associated with reducing contaminants.

Active Conservation

Through the Conservation Efforts Database (CED), the Service collected information relating to conservation actions that were completed, in progress, or planned. Based on a summary report of that information created on XXXXXX, the following table indicate the number of actions and approximate areas for threat amelioration. These numbers are self-reported; the Service will further review and certify these actions if they are pivotal to any determination.

The Service addresses regulatory actions in a separate chapter????

Table 2: List of Conservation Efforts (ameliorating threat described in this chapter) by management zone

Management Zone	Type of Conservation Effort	Sum of Acres or Miles	Number of Actions	Notes

1
2
3
4
5
6
7

Threat Amelioration Summary

asdfasdf

ASSESSMENT OF POTENTIAL THREAT

Sources of contaminants to wildlife associated with human activities have increased since the 19th century and will likely continue to occur across the species range, potentially impacting air and water quality and vegetation and insect quantity. While contaminants may impact sage-grouse individuals, it is unlikely that contaminants will lead to widespread mortality or declines in sage-grouse populations across management zones, as contamination exposure is typically localized or ~~and~~ sporadic~~ally occurs across the range~~.

CITATIONS

Adams, D.J. and T.M. Pickett. 1998. Microbial and cell-free selenium bioremediation in mining waters. In: *Environmental Chemistry of Selenium*, W.T. Frankenberger, Jr. and R.A. Engberg, eds. Marcel Dekker, Incl. New York, NY, pp. 479-499.

Albers, P.H. 1978. The effects of petroleum on different stages of incubation in bird eggs. Bulletin of Environmental Contamination and Toxicology 19:624-630.

Alstad, D.N. and G.F. Edmunds, Jr. 1982. Effects of air pollutants on insect populations. Annual Review of Entomology 27:369-384.

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Animal and Plant Health Inspection Service (APHIS). 2002. U.S. Department of Agriculture. Rangeland grasshopper and mormon cricket suppression program. Final Environmental Impact Statement. Riverdale, MD. 283 pp.

Baker, M.F., R.L. Eng, J.S. Gashwiler, M.H. Schroeder, and C.L. Braun. 1976. Conservation committee report on effects of alteration of sagebrush communities on the associated avifauna. The Wilson Bulletin 88:165-171.

Beyer, W.N., J. Dalgarn, S. Dudding, J.B. French, R. Mateo, J. Miesner, L. Sileo, J. Spann. 2004. Zinc and lead poisoning in wild birds in the tri-state mining district (Oklahoma, Kansas, and Missouri). Archives of Environmental Contamination and Toxicology. 48:108-117.

Blus, L.J. and J.W. Connelly. 1989. Effects of organophosphorus insecticides on sage grouse in southeastern Idaho. Journal of Wildlife Management 53:1139-1146.

Blus, L.J. and J.W. Connelly. 1998. Radiotelemetry to determine exposure and effects of organophosphorous insecticides on sage grouse. Pages 21-29 In Brewer, L.W. and K.A. Fagerstone, eds. Proceedings Workshop Radiotelemetry Applications for Wildlife Toxicology Field Studies, January 5-8, 1993. Pacific Grove, California. Society of Environmental Toxicology and Chemistry, Pensacola, Florida. 224 pp.

Blus, L.J., C.S. Staley, C.J. Henny, G.W. Pendleton, T.H. Craig, E.H. Craig, and D.K. Halford. 1989. Effects of organophosphorus insecticides on sage grouse in southeastern Idaho. Journal of Wildlife Management 53:1139-1146.

Call, M.W. and C. Maser. 1985. Wildlife habitats in managed rangelands - The Great Basin of southeastern Oregon sage grouse. General Technical Report PNW-187, U.S. Department of Agriculture, Forest Service, La Grande, OR. 30 pp.

Carr 1968, as cited in Call and Maser 1985, p. 15

Christiansen, T.J. and C.M. Tate. 2011. Parasites and infectious disease of greater sage-grouse. Studies in Avian Biology. 47 pp.

Connelly, J.W. and O.D. Markham. 1983. Movements and radionuclide concentrations of sage grouse in southeastern Idaho. Journal of Wildlife Management 47:169-177.

Connelly, J.D., S.T. Knick, M.A. Schroeder, and S.J. Stiver. 2004. Conservation assessment of greater sage-grouse and sagebrush habitats. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, Wyoming.

Cuesta, N., A. Martinez, F. Cuttitta, and E. Zudaire. 2005. Identification of adrenomedullin in avain type II pneumoncytes: Increased expression after exposure to air pollutants. Journal of Histochemistry and Cytochemistry. 53:773-780.

Culverwell, W. 2015. NuScale hires an energy giant to help get its nuclear plant certified. Portland Business Journal. Portland, Oregon.

Dahlen, J.H. and A.O. Haugen. 1954. Acute toxicity of certain insecticides to the bobwhite quail and mourning dove. Journal of Wildlife Management 18:477-481.

Eng, R.L. 1952. A two-summer study of the effects on bird populations of chlordane bait and aldrin spray as used for grasshopper control. Journal of Wildlife Management 16:326-337.

Gibbons, D., C. Morrissey, and P. Mineau. 2015. A review of the direct and indirect effects of neonicotinoids and fipronil on vertebrate wildlife. Environmental Science and Pollution Research 22:103-118.

Hansen, J. A., D. Audet, B.L. Spears, K. A. Healy, R.E. Brazzle, D.J. Hoffman, A. Dailey, W.N. Beyer. 2011. Lead exposure and poisoning of songbirds using the Coeur d'Alene River Basin, Idaho, USA. Integrated Environmental Assessment and Management 7:587-595.

Helmig, Detlev, et al. "Highly elevated atmospheric levels of volatile organic compounds in the Uintah Basin, Utah." *Environmental science & technology* 48.9 (2014): 4707-4715.

Hoffman, D.J. and M.L. Gay. 1981. Embryotoxic effects of benzo[a]pyrene, chrysene, and 7,12-dimethylbenz[a]anthracene in petroleum hydrocarbon mixtures in mallard ducks. Journal of Toxicology and Environmental Health 7:775-787.

Johnson, G.D. and M.S. Boyce. 1991. Survival, growth, and reproduction of captive-reared sage grouse. Wildlife Society Bulletin 19:88-93.

Kennedy et al. 1990.

Knick, S.T., S.E. Hanser, R.F. Miller, D.A. Pyke, M.J. Wisdom, S.P. Finn, E.T. Rinkes, and C.J. Henny. 2011. Ecological influence and pathways of land use in sagebrush. Studies in Avian Biology. 162 pp.

Larson et al. 1999

Macey et al. 2014.

Martin. 1970.

McEwen, L.C. and R.L. Brown. 1966. Acute toxicity of dieldrin and malathion to wild sharp-tailed grouse. Journal of Wildlife Management 30:604-611.

Miller et al. 2011.

Mineau, P. and C. Palmer. 2013. The impact of the nation's most widely used insecticides on birds: neonicotinoid insecticides and birds. Amercian bird conservancy report.

Moore and Mills. 1977.

Nuclear Energy Institute (NEI). 2008. New nuclear plant status. http://www.nei.org/resourcesandstats/documentlibrary/newplants/graphicsandcharts/newnuclearplantstatus/.

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Olsgard, M.L. G.R. Bortolotti, B.R. Trask, and J.E.G. Smits. 2008. Effects of inhalation exposure to a binary mixture of benzene and toluene on Vitamin A statue and humoral and cell-mediated immunity in wild and captive American kestrels. Journal of Toxicology and Environmental Health, Part A. 71:1100-1108.

Olsgard, M.L. 2007. Toxicological evaluation of inhalation exposure to benzene and toluene in a raptorial bird, the American kestrel, *Falco sparverius*. University of Saskatchewan.

Olsgard. 2007.

Pristos and Ma. 1997.

Ramirez, Jr., P. and B.P. Rogers. 2002. Selenium in a Wyoming grassland community receiving wastewater from an in situ uranium mine. Archives of Environmental Contamination and Toxicology 42:431-436.

Rands. 1985.

Schroeder, M.A., J.R. Young, and C.E. Braun. 1999. Sage grouse (Centrocercus urophasianus). 28 pages In Poole, A. and F. Gill, eds. The Birds of North America, No. 425. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Vale. 1974.

Willis, M.J., G.P. Keister, Jr., D.A. Immell, D.M. Jones, R.M. Powell, and K.R. Durbin. 1993. Sage grouse in Oregon. Wildlife Research Report No. 15. Oregon Department of Fish and Wildlife, Portland, OR. 77 pp.

Wolfenbarger et al. 2000.

U.S. Bureau of Land Management (BLM). 2008~~d~~.

U.S. Fish and Wildlife Service (FWS). 2013. Greater Sage-grouse (Centrocercus urophasianus) Conservation Objectives: Final Report. U.S. Fish and Wildlife Service, Denver, CO. February 2013.

University of Illinois. 2002.

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