Roxann B Borisch

From: TBar <tbar280@gmail.com>
Sent: Thursday, May 18, 2017 8:35 AM
To: roxann.b.borisch@state.or.us
Subject: 2017 Oregon Wolf Plan Review

Oregon Department of Fish & Wildlife May 17, 2017

Regarding the 2017 Oregon Wolf Plan Draft

I am unable to attend the May 19, 2017 Commission meeting. Please add my comments to the official record. I will be brief.

- Best Science – Most everyone agrees that wolf management should be based on the best science. Yet ODFW is continually bombarded with polls, surveys, and letter-writing campaigns. Public pressure tactics directly contradict the "best science" ideology proclaimed by many.
- Hunting – The wolf hunting component is nothing new. It has been in Oregon's wolf plan since day one. Hunting has now become unacceptable for some groups that have participated in writing "the best wolf plan in the U.S." since the very beginning. Is good-faith bargaining and honoring commitments a thing of the past?
- Funding – Most Oregonians think ODFW is funded by their income taxes. In fact, the $30 million General Fund tax component of ODFW's budget is just **.16%** of the $18 billion total allocated by Legislature this biennium. Program costs for wolf research, collars, telemetry, pathology, anti-poaching efforts, depredation investigations, etc ….continue to climb. Unless people buy Oregon licenses and tags, or sporting goods (Pittman-Robertson Act), they contribute essentially nothing to Oregon's wildlife. Legislature should be embarrassed by their lack of financial support for ODFW.
- Support – Wolf advocacy groups are now stating that without some changes, they are unable to support the 2017 Oregon Wolf Plan revision. ODFW has been repeatedly sued by some of the very groups that helped write the original 2005 plan, as well as the 2010 and 2017 revisions. So one must ask:

  What plan components must be sacrificed to gain advocacy group support?

  Is there any tangible benefit to ODFW in obtaining advocacy group support?

  Will changes negatively affect the interests previously negotiated by others?

- According to Dr. Phil, the best predictor of future behavior is past behavior. That said, the Commission might ask: Will bowing to the demands of wolf advocates insulate the agency from future legal action? Based on history, the logical answer is NO.

For the fifth time I will publicly state that I am not a wolf – hater. I am a realist. Wolves are here to stay. So we need to properly manage them, right along with the rest of Oregon's wildlife.

Respectfully,

Tim Bar-bow-lee-tuss

Bend, OR

BROKEN BOX RANCH
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April 21, 2017
Mr. Chair and Commission Members,
Thank you for the opportunity to provide public comment.
My wife Bev & I farm and ranch north of Beatty, Oregon in the eastern portion of Klamath County. We have called this our home for 40 years. We have been actively involved in the natural resource issues for almost as many years. I am a past Klamath County Commissioner. As a County Commissioner, I was a member of the County's Wolf Depredation Compensation Committee.
Late last night I read a recent article entitled **"Finding Balance with a New Apex Predator".**

There was nothing really new brought forward, just another account of struggling rural Oregon chasing that elusive "balance".

Yesterday, at the Commission tour, I also spoke about this ongoing desire for balance. For about 20 years, as part of our operation, we ran a herd of about 200 mother cows, calving in the spring. It was not uncommon to have coyotes in our herd while calving. They seemed to serve a purpose in cleaning up the blood and afterbirth during the calving time. We felt, this in turn, helped keep the cougars from visiting our herd. In the summertime, coyotes also fed on mice, squirrels, and pocket gophers, even following our hay swather for hours at a time

literally waiting for "delivery service". However, sometimes we had to eliminate an aggressive coyote or two.

In the 20 years, we only had one depredation attributed to a coyote. Other friends and neighbors had more serious problems than we did. Even then, we did not go out and eliminate every coyote in the valley. This shows balance.

Let's be perfectly honest, a coyote is NOT, by definition, an "Apex Predator", but a wolf certainly is. To have any possible balance, the number of breeding pairs has to be minimal and not restricted to the rural areas. If wolves are to be fully re-introduced in Oregon, then they should be promoted state wide. If those that cherish the sound of a howling wolf pack at night let that happen in their backyard as well. After all, wolves were present to some extent, throughout the state at one time or another.

Within our various government agencies, we have a lot of great, passionate & dedicated employees, doing their job. However, generally speaking, there has been a growing lack of trust.

About 1989-1990, when wolves were first being considered to be re-introduced into Idaho, there was a meeting held here in Klamath County at the Fair Grounds, on this proposal. A number of us asked the obvious question of what happens when the wolves end up crossing into Oregon. We were assured we would certainly be allowed to protect ourselves and our livestock. That hasn't worked out too well.

A few years ago, I attended a meeting at the local college dealing with a government department's upcoming budget. A comment was made that this department was going to have its budget cut. However,

looking at the staff and financial numbers from the past, it was obvious their budget was actually increasing. The explanation was that they were not receiving as much of an increase as they had projected in the proposed budget. This, they reasoned, was a budget cut.

Currently, the Wolf Management Plan appears to be moving along with changes being made, widely ignoring producers, citizens and those that are being affected the most. This is not a way to increase faith in our government partners.
Please keep in mind that rural Oregon has been working in good faith to find that balance living with this Apex Predator, and we expect the same in return.

Thanks again for your time and service.

Tom & Bev Mallams

CENTER for BIOLOGICAL DIVERSITY Because life is good.

May 19, 2017

Michael Finley, Chair
Oregon Fish and Wildlife Commission
4034 Fairview Industrial Drive SE
Salem, OR 97302

Testimony of Center for Biological Diversity on 5-Year Oregon Wolf Plan Update

Chair Finley, Members of the Commission, Director Melcher:

Good morning, and happy National Endangered Species Day.

My name is Amaroq Weiss. I'm the West Coast Wolf Advocate for the Center for Biological Diversity, and am here today speaking for our nearly 28,000 Oregon members and supporters.

We greatly appreciate being part of this invited panel. We also will submit a more detailed comment letter by the end of the month.

In my 10 minutes, I will describe our perspectives on a few select plan topics, and the views of several scientists whose research is cited in the plan and who sent you comments letters this week.

On Social Tolerance

It's the right thing for the Department to do – to acknowledge that *no* science has demonstrated that killing wolves increases social tolerance, and to *remove* all such inferences from the plan. The *only* peer-reviewed science on this subject concludes just the opposite: That permitted killing of wolves by agencies and by private citizens is instead associated with *decreased* social tolerance and *increased* poaching of wolves.

The public – and wolf conservation – depend on the Department keeping up with current best available science, so we thank ODFW for mostly removing from the plan outdated and unfounded assertions on killing wolves and social tolerance, and urge removal of the rest.

That said, where the plan *does* now include discussions of a small portion of the latest science on this topic, it misrepresents the work of the top scientists in this field. This part of the plan needs to be fixed; a phone call by Department staff to Dr. Adrian Treves and other experts could go a long ways to ensuring the conclusions from their work are accurately reported.

Amaroq Weiss, West Coast Wolf Advocate • 911 Lakeville Street #333 • Petaluma, CA 94952
Phone: 707-779-9613 • Fax: 800-637-7457 • aweiss@biologicaldiversity.org

On a Western Zone Analysis

We strongly support the Department's commitment, in Chapter II, to conduct a western zone analysis when moving from Phase I to Phase II in that region. As the Department describes it, this analysis will be conducted with conservation threats in mind and, the Department says, its outcome could result in the need by the commission to adopt additional conservation measures. We thank the Department for its foresight in applying the scientific "better safe than sorry" (precautionary) principle. We hope ODFW will remain steadfast in its commitment to conduct this analysis – as we foresee likely forceful political pressure to simply kill more wolves over time under the rubric of adaptive management.

On the Use of Rigorous and Sound Scientific Approaches

In Chapter VIII, on Research and Information Management, we disagree when ODFW states that partnerships and cooperative research are how to "ensure a rigorous and sound scientific approach when conducting wildlife research." We maintain that what is *truly* needed is to include peer review by outside expert scientists and use of gold-standard research design.

On the New Section on Potential Conservation Threats

This next section is long. Or, rather, the *section* is not long but our comments are.

We applaud the Department's addition of this section in Chapter II. That said, it fails to discuss several clear, known threats to wolves and actions to address them.

First, it fails to identify human activities currently lawful in Oregon which pose conservation threats to wolves and which should be addressed legislatively or through rule-making. These are:

- the state allowance of coyote-killing contests,
- night-hunting of coyotes, and
- the use of lethal traps and snares for coyotes and other native wildlife in wolf habitat.

In areas wolves are recolonizing they frequently are mistaken for coyotes – or claimed to be mistaken for coyotes – and shot, or are incidentally caught in traps set for other species.

- According to ODFW's 2015 gray wolf status report, at least 4 known wolves in Oregon have been incidentally captured in traps set for coyotes;
- Two years ago a coyote hunter in Grant County shot and killed a wolf; and
- Just three months ago, wolf OR-48 of the Shamrock Pack was killed by an M-44 cyanide bomb placed on private land by Wildlife Services to kill coyotes.

Secondly, the plan fails to adequately discuss the conservation threats to wolves posed by poaching. At the top of page 19, the plan devotes five sentences to this topic, cites to only two of the many recent papers on wolf poaching and, in both cases misrepresents the conclusions of the authors.

A more accurate and robust discussion of the published literature on wolf poaching will inform readers that:

(1) In all four U.S. endangered wolf populations, agencies underestimate poaching by 16 to 44 percent;
(2) Most poaching is cryptic and goes undetected such that, where studies have been conducted, for every poached wolf recovered, there exist either one or two additional poached wolves that are not recovered; and
(3) Killing of wolves in both agency actions and in state-sanctioned wolf hunting and trapping is linked to increased poaching of wolves.

Why are these findings so significant for the conservation of Oregon's wolves: Three reasons:

- First, provisions allowing agency killing of wolves at increasingly lower thresholds of depredation, as proposed for Phases II and III, may encourage poaching.
- Second, provisions allowing the agency to deputize citizens to hunt and trap wolves may encourage poaching.
- Lastly, incorrect calculations made in ODFW's 2015 population viability analysis (or "pva") result in an underestimate of poaching deaths and thus of wolf mortality rates in Oregon.

In his comment letter to you, Dr. Treves exposes this mathematical error – an error which he reports in a paper published just today in the Journal of Mammalogy has been made by agencies in all four endangered wolf population recovery areas. In Dr. Treves' letter to you, he concludes that Oregon's current wolf mortality rate *likely already exceeds* the thresholds ODFW's pva predicts will result in conservation failure and a high risk of extinction. This means any additional regulated killing allowed by the plan will be imposed on a wolf population whose current mortality rate is likely *already unsustainable*.

<u>On the Plan's Failure to Discuss Ecological Benefits of Wolves</u>
Hundreds of peer-reviewed science papers exist on the ecological benefits of restored wolf populations, due to at least two decades of research on this subject since federal wolf recovery efforts began. Prior versions of Oregon's wolf plan had but a few paragraphs on the subject because the published literature was just emerging. Yet instead of enhancing this section of the plan, we were stunned to see the new draft plan has *removed* all discussion of this topic but for one sentence.

Species conservation plans *must* strive to promote public appreciation for the species. This is critical to engender support for the species' conservation. Published studies show that people are more willing to change their own behaviors to improve chances for successful wildlife conservation once informed of a species' ecological benefits.

In failing to discuss the ecological role of wolves, trophic cascades and the benefits of wolf populations restored to ecologically-effective levels, the plan totally misses the boat. The plan deprives its readers of the opportunity to learn about what is likely the most scientifically significant story resulting from the wolf restoration efforts of the past two decades.

To be effective, the wolf plan needs to explain to the public *why* wolves should be conserved.

Conclusion

I will conclude with a few remarks from the comments sent to you by three scientists who are cited in the plan, giving their expert opinions on the wolf plan.

From Dr. Adrian Treves, Professor of Environmental Studies at University of Wisconsin-Madison, Carnivore researcher with more than 63 peer-reviewed publications on ecology and conservation:

"I am one of the scientists cited in the OWCMP. I believe my work has been misrepresented, and that conclusions reached by other scientists cited in the plan also have been misrepresented."

". . . the OWCMP is not transparent and does not use the best available science."

From Dr. Robert L. Beschta, Professor Emeritus at Oregon State University; Author or coauthor of approximately 40 peer-reviewed research articles on trophic cascades:

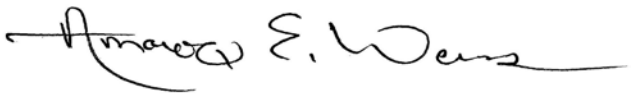
"There is little information in the Oregon wolf plan that might help Oregonians understand the ecological importance of conserving wolves."

From Dr. Michael P. Nelson, Professor of Environmental Ethics and Philosophy at Oregon State University; Author of more than 100 peer-reviewed research articles including in leading ecology, ethics, conservation and animal science journals:

". . . I find a collection of errors in this plan that, collectively, demonstrate a systematic – *i.e.*, non-random – perspective that scientists would likely refer to as bias (in the formal sense), a bias in favor of the state-sanctioned killing of wolves."

While we support some of the additions proposed for the plan, we think there is much room for improvement. These scientists agree. We hope ODFW staff take the time to contact these experts, each of whom always welcomes the chance to discuss their work with fellow researchers and state wildlife managers.

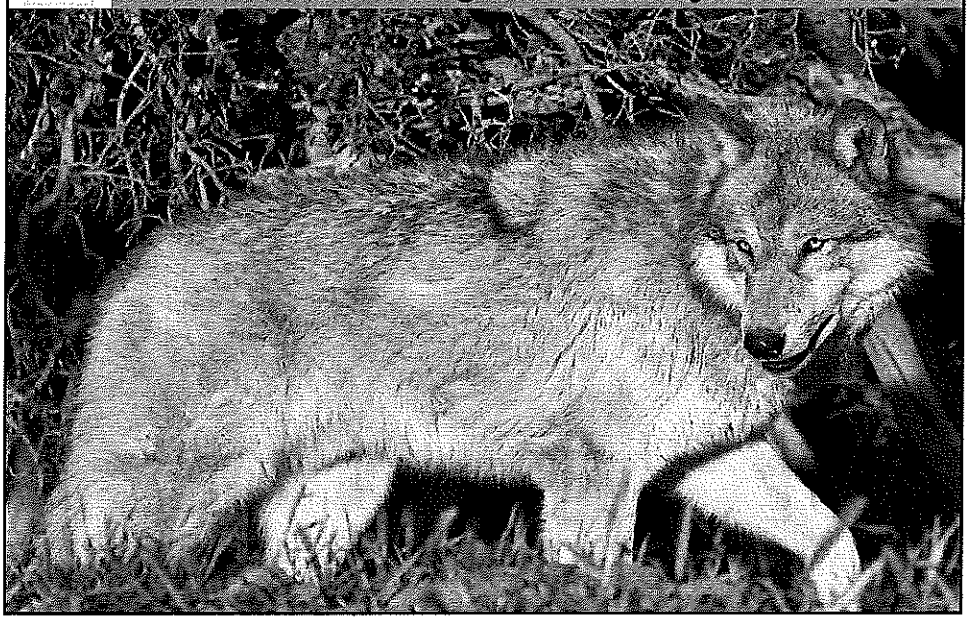
Thank you for allowing us this time to address you.



Amaroq Weiss, M.S., J.D.
West Coast Wolf Advocate
Center for Biological Diversity

Oregon Wolf Plan Update 2017

Center for Biological Diversity Testimony



Topics

- Social Tolerance
- Western Zone Analysis
- Use of Rigorous and Sound Scientific Approaches
- Potential Conservation Threats
- Ecological Benefits of Wolves
- Some Scientist Comments on the OWCMP

Social Tolerance

- No science has demonstrated that killing wolves increases social tolerance.
- Instead, killing of wolves by agencies and private citizens is linked with decreased social tolerance and increased poaching of wolves.
- **Recommendation:**
  - **Remove all inferences from the plan that allowing killing of wolves increases social tolerance.**
  - **Discuss with literature authors their conclusions, so they may be correctly represented.**

Western Zone Analysis

- **Excellent example of "precautionary principle"**
- **Recommendation:**
  Remain steadfast in commitment to conduct this analysis.

Use of Rigorous and Sound Scientific Approaches

- Ensure a rigorous and sound scientific approach when conducting wildlife research

- Recommendation:
  - Peer review by outside expert scientists
  - Use of gold-standard research design

"We found her wandering at the edge of the forest. She was raised by scientists."

Potential Conservation Threats to Wolves

Lawful Actions Aimed at Coyotes

Coyote-killing contests

Night-hunting of coyotes

Use of lethal traps/snares for coyotes & other wildlife in wolf habitat

Wolf Poaching

Underestimates of poaching by 16-44 %

Most poaching cryptic

Permitted killing of wolves in control actions & sanctioned hunting, trapping linked to increased poaching

Why Findings on Poaching are Significant for Conservation of Oregon's Wolves

1) Provisions allowing agency killing of wolves at increasingly lower depredation threshholds may encourage poaching.

2) Provisions allowing deputization of citizens to hunt/trap wolves may encourage poaching.

3) Incorrect calculations in ODFW's 2015 PVA underestimates poaching deaths, wolf mortality rates.

   - Current wolf mortality *likely exceeds* PVA estimates for conservation failure and extinction risk.
   - Regulated killing allowed by the plan is in addition to *likely already-unsustainable mortality rate.*

Figure 1. Conceptual diagram indicating direct (solid lines) and indirect (dashed lines) effects of gray wolf reintroduction into the Greater Yellowsto

Ecological Benefits of Wolves

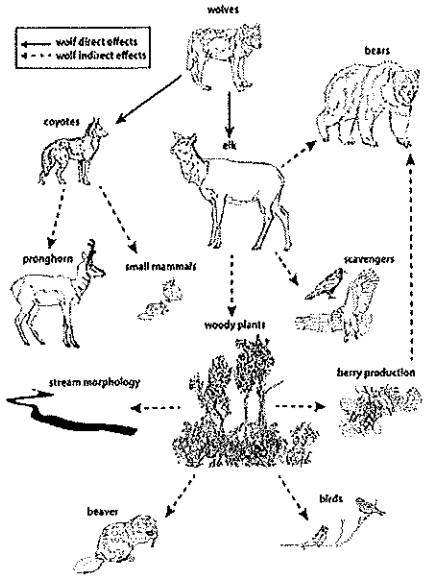


Figure 1. Conceptual diagram indicating direct (solid lines) and indirect (dashed lines) effects of gray wolf reintroduction into the Greater Yellowstone ecosystem, all supported by peer-reviewed research and publications. This is a simplified diagram and not all species and trophic interactions are shown.

Adapted from: Ripple et al. (2014); see also Beschta and Ripple (2012), Ripple et al. (2015).

Why Include Section on Ecological Benefits of Wolves

- Promotes public appreciation for wolves
- People more willing to modify own behaviors to increase likelihood of successful wolf conservation
- Most scientifically significant story from wolf restoration
- Plan must explain why wolves should be conserved

Room for Improvement: Scientist Comments on OWCMP

"I am one of the scientists cited in the OWCMP. I believe my work has been misrepresented, and that conclusions reached by other scientists cited in the plan also have been misrepresented."

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Mismeasured mortality: correcting estimates of wolf poaching in the United States

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Measuring rates and causes of mortalities is important in animal ecology and management. Observing the fates of known individuals is a common method of estimating life history variables, including mortality patterns. It has long been assumed that data lost when known animals disappear were unbiased. We test and reject this assumption under conditions common to most, if not all, studies using marked animals. We illustrate the bias for 4 endangered wolf populations in the United States by reanalyzing data and assumptions about the known and unknown fates of marked wolves to calculate the degree to which risks of different causes of death were mismeasured. We find that, when using traditional methods, the relative risk of mortality from legal killing measured as a proportion of all known fates was overestimated by 0.05–0.16 and the relative risk of poaching was underestimated by 0.17–0.44. We show that published government estimates are affected by these biases and, importantly, are underestimating the risk of poaching. The underestimates have obscured the magnitude of poaching as the major threat to endangered wolf populations. We offer methods to correct estimates of mortality risk for marked animals of any taxon and describe the conditions under which traditional methods produce more or less bias. We also show how correcting past and future estimates of mortality parameters can address uncertainty about wildlife populations and increase the predictability and sustainability of wildlife management interventions.

Key words: carnivore, endangered species, illegal, lethal control, mark–recapture, regulated take

An accurate understanding of causes of death in animal populations is important for effective management and legitimate policy. Contemporary study of wild animal populations has benefited enormously from mark–recapture methods to estimate life history variables, such as mortality. However, marked animals in such studies sometimes elude recapture, which leads to loss of data (i.e., unknown fates). When the proportion of unknown fates among marked animals is low, the potentially biasing effects of data loss might be correspondingly low. Also, when the mortality risks for unknown fates are very similar to those for known fates, the loss of data should not bias the estimates of life history traits (i.e., this would be "uninformative censoring"). The traditional presumptions in most studies are that marked animals disappear because they moved out of range of telemetry or the transmitter technology affixed to the animal failed, but otherwise researchers assume the life and death of those animals proceeded as it would otherwise have done. We examine this assumption for wolves (*Canis lupus* and *C. rufus*) in the United States, and emerge with a generalizable insight broadly applicable to many taxa.

Although early research on grizzly bears (*Ursus arctos*) suggested data loss was biased when humans destroyed radiotransmitters (McLellan et al. 1999), this idea was not quantified for gray wolves (*C. lupus*) until study of the mortality and poaching of Scandinavian wolves (Liberg et al. 2012). When Adams et al. (2008) documented that 74% of human-caused deaths went unreported in an Alaskan gray wolf population, even that high rate of loss of data on wolves did not raise

concerns, perhaps because unreported killing seemed inconsequential to a large, resilient wolf population. Later, parallel analyses of Northern Rocky Mountain (NRM) gray wolves appeared to accept the assumption of uninformative censoring (Murray et al. 2010). They cited unpublished analyses showing that including dead radiocollared wolves for which cause of death could not be inferred did not produce "qualitatively different results" (Murray et al. 2010:2517). Those unpublished analyses of recovered marked wolves whose cause of death was unknown are not peer-reviewed as of the time of writing. That same year, some of the same authors published another mortality analysis (Smith et al. 2010), in which they inferred that some marked wolves of unknown fates dispersed and eluded telemetry, because the proportion of suspected dispersers that disappeared (31.4%) differed from the proportion (18.1%) of known residents that disappeared. High-altitude aerial telemetry conducted intensively across the recovery areas was oriented to locating dispersers because of the importance of such events (Bangs and Fritts 1996). Smith et al. (2010) analyzed the last known locations prior to disappearances to infer that modestly informative censoring was present and the locations of disappearance were not in areas of high human activity, therefore "associated principally with dispersal status rather than human-caused mortality" (Smith et al. 2010:632). That inference hinges on the hypothesis that levels of poaching would be higher in areas of higher human activity. However, we suggest that strict protection of wolves might alternatively have made people reluctant to kill a wolf where the likelihood of witnesses seemed higher. If so, locations more prone to poaching might instead include more remote areas. Remote hunting zones might reasonably be implicated given that recent research on inclination to poach indeed implicates hunters in both the NRM and in the state of Wisconsin (Treves and Martin 2011; Treves et al. 2013; Treves et al. 2017a). After Liberg et al. (2012), attention to poaching grew in the wolf research community.

Studying Scandinavian gray wolves, researchers estimated the major cause of death was poaching, which accounted for 51% of all mortality (poaching risk). An estimated 66% of that poaching went unreported (Liberg et al. 2012). Because the study reconstructed the fates of poached wolves that went missing, it drew attention to—and undermined—the previously held assumptions that a small proportion of marked animals disappeared and that data loss was minimal. It also raised questions about the assumption that unknown fates resembled known fates in mortality risk and rate (i.e., censoring was informative in the Scandinavian study). Further evidence of a problem with the latter assumption followed reanalysis of data from Adams et al. (2008), working in the Brooks Range of Central Alaska. Schmidt et al. (2015) reported at least 15% higher mortality among unmarked gray wolves compared to their marked pack-mates. In contrast, another Alaskan study around Denali National Park and Preserve reported that marked wolves suffered higher rates of regulated killing (Borg et al. 2016). These study sites in Alaska, however, differed. The former had few roads, and few people, whereas the latter had more of both suggesting that the relative risk from humans for marked and unmarked animals might be influenced by whether humans can detect collars and are killing wolves legally. A study in Wisconsin, across a landscape with denser human activity including many roads, people, livestock, hunters, hounds, etc., produced an estimated 28% higher mortality rate for unmarked gray wolves than for marked wolves when illegal killing comprised almost half of all deaths (Treves et al. 2017b). Despite current uncertainty about why marked or unmarked wolves face different rates of mortality from humans in different systems, all these studies converge to suggest that the traditional assumption is unsupported: fates of marked wolves do not seem to accurately represent the risk and rates of mortality for the broader population.

Based on the above, we test whether unknown fates of marked wolves cause important losses of information that would bias results. We also test the specific hypothesis that poaching is systematically underestimated when data from wolves of unknown fates are omitted. We reanalyzed data from 4 populations of wolves in the United States (2 populations of gray wolves, *C. lupus*; 1 population of Mexican gray wolves, *C. l. baileyi*; and 1 population of red wolves, *C. rufus*). Although our results are specific to wolves, we identify a general mechanism that applies to studies of other species whose mortality can be divided into deaths where the cause is known and deaths where the cause is unknown.

Materials and Methods

We define legal killing to include regulated harvest or government removal of a protected animal, as long as the death was reported after a permitted activity. We define poaching as any non-permitted killing in which the actor intended to kill an animal (trapping, poison, shooting, etc.), as opposed to most vehicle collisions in which the driver likely does not intend to kill any animal. This definition of poaching is justified under the Endangered Species Act because the U.S. Congress of 1973 explicitly made it illegal to kill a listed species regardless of "knowingly" doing so (Newcomer et al. 2011). Also, we redefine "known fates" and "unknown fates" from their common usage for marked animals. We define known fate as any marked animal whose cause of death is confirmed (i.e., excluding marked animals whose remains are recovered but are assigned to "unknown cause" of death, and excluding marked animals that disappear). Importantly, we differ from several other authorities by highlighting that "unknown cause" of death never includes legal killing (because, by definition, a legal kill must be reported so its cause is known). Finally, many studies of marked animals have to contend with the possibility that a marked animal that disappeared is still alive but has eluded monitoring. We avoid this difficulty for all 4 populations under analysis by restricting ourselves to older time periods, so radiocollared wolves could not still be alive today.

Section 1: calculating the bias in mortality estimates.—We begin with the mathematics underlying estimation of risk of mortality, defined as the proportion of all deaths attributable to a given cause. The traditional assumption was that data lost from unknown fates was uninformative, because the marked

animals with known fates ostensibly represented all marked animals' fates. This assumed the relative risks of different causes of death were approximately equivalent in marked animals of known and unknown fates. However, marked animals of unknown fate never die from perfectly documented causes, such as legal killing, or they would not have disappeared. Therefore, the animals of known fate cannot represent the animals of unknown fate accurately (Fig. 1A).

The mismatch between animals of known fate and those of unknown fate introduces error that is not random but systematic (biasing). The error is always in the direction of underestimating the risk posed by inaccurately documented causes of death because these sometimes lead to unknown fates. Conversely, overestimation of risks of the perfectly documented causes of death (e.g., legal killing in our context) occurs because these causes are not represented among the unknown fates at all. Therefore, the traditional assumption that marked animals of known fate represent fates of all marked animals is inaccurate as a mathematical fact. The only question that remains is how large the inaccuracy might be. We use the method in Table 1A to estimate how much the risk of legal killing has been overestimated in its proportional contribution to total mortality in endangered wolves.

As legal killing increases, the bias caused by discarding information on unknown fates increases (Fig. 1B). As the number of unknown fates (m) increases, so too does the bias. The bias increases proportionally to both legal kills and m because each additional individual of unknown fate results in increased underestimation of inaccurately documented causes, whereas each additional legal kill results in increased overestimation of the contribution of legal kills. By accounting fully for all marked animals ($n + m$) and by estimating the unknown variables (Figs. 2A and 2B; Table 1B), we extract more information from the sample of marked animals than done traditionally. The arithmetic described in Table 1A and Fig. 1 is a mathematical fact. But we can extract yet more information from well-documented cases if we split the causes of death as in Table 1B and consider the role of P, which estimates cryptic poaching.

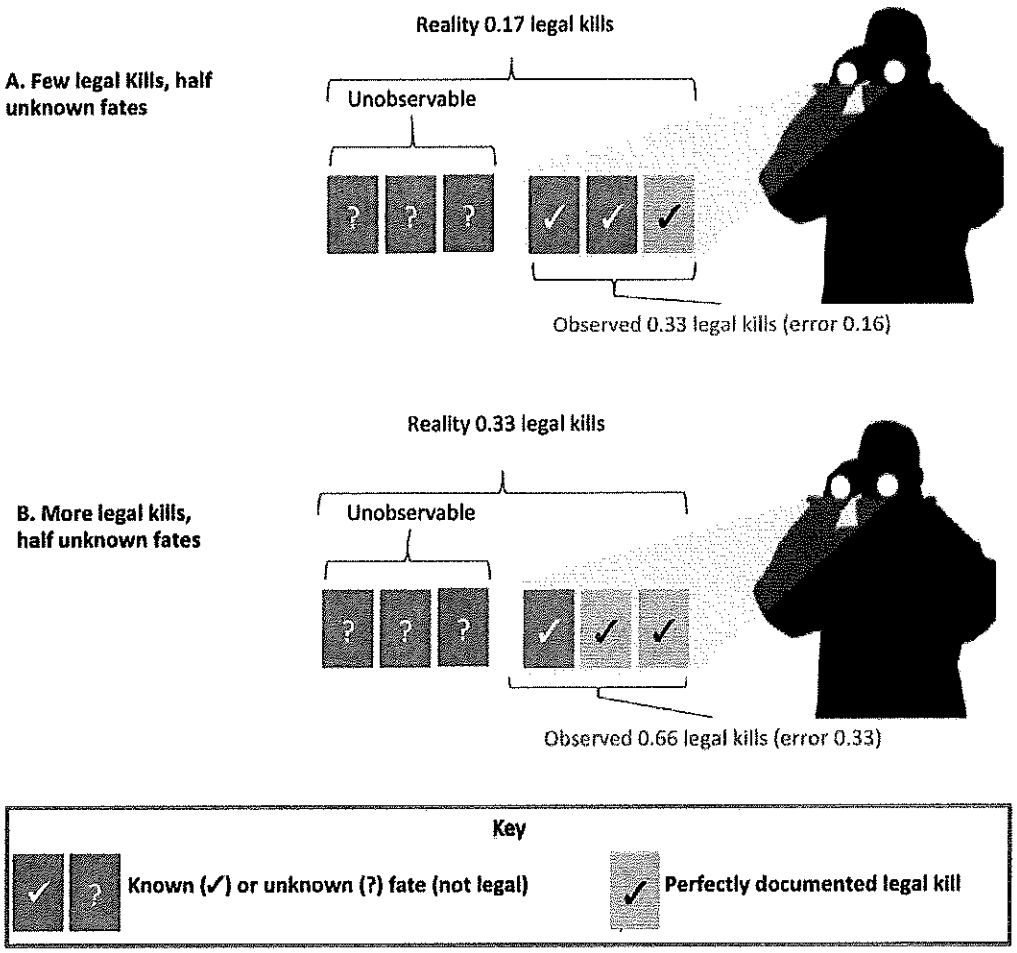

Fig. 1.—Systematic bias in calculating the risk of mortality from legal killing when some marked animals have unknown fates (unobservable with question marks ?) and causes of death vary in the accuracy of documentation. The green squares represent legal kills (perfectly documented) and the blue squares denote other causes of death (inaccurately documented). Observed (silhouette with binoculars) known fates (check marks ✓, and calculation in red text) alone would overestimate the real risk of legal killing. A) Positive bias in estimating risk of legal killing is 0.16. B) Positive bias increases by 0.17 as the proportion of legal kills increases.

Table 1.—Estimating the relative risk of mortality as a proportion of marked animals, when marked animals disappear (unknown fates). A) Equal numbers of known and unknown fates, 1 perfectly documented cause of death (legal killing) and 1 inaccurately documented cause of death. B) The general expression for any n known fates and m unknown fates with 3 causes of death. Prior values are precise and accurate for n (number of known fates), m (number of unknown fates), *Legal* (number of marked animals killed legally), $Observed_{non}$ (number of marked animals of known fate that died from nonhuman causes), $Observed_{oh}$ (number of marked animals of known fate that died from human causes other than legal killing), and $Expected_{non} + Expected_{oh}$ (the number of marked animals of unknown fate expected dead from nonhuman and other human causes, respectively) sum to m but have uncertain values. Unknown fates include recovered carcasses with unknown cause of death. P is the number of marked animals of unknown fate expected dead from cryptic poaching following equation 2.

Causes of death	Mortality risk for marked animals		
A)	Known fates (50)	Unknown fates (50)	Known + unknown fates (100)
Perfectly documented legal killing	0.20	0[a]	0.10
Inaccurately documented causes	0.80	1.00	0.90
B)	Known fates (n)	Unknown fates (m)	Known + unknown fates ($n + m$)
Legal killing	$Legal/n$	0[a]	$Legal/(n + m)$
Nonhuman causes	$Observed_{non}/n$	$Expected_{non}/m$	$(Observed_{non} + Expected_{non})/(n + m)$
Other human causes	$Observed_{oh}/n$	$(Expected_{oh} + P)/m$	$(Observed_{oh} + Expected_{oh} + P)/(n + m)$

[a]Legal kills must be reported (all known fates) or they are not legal.

Our approach is more efficient because additional information is acquired from the sample of marked individuals.

Section 2: estimating unknown fates.—A failure to document death of a marked animal can occur because poachers concealed evidence or because the marked animal eluded monitoring prior to death (Supplementary Data SD1). Eluding monitoring prior to death means a marked animal lived for a time and then died undocumented—at least undocumented by the same method used on marked animals of known fate. It might be reasonable to assume such marked animals are represented well by the known fates, because eluding monitoring does not necessarily imply systematic change in risk. However, if poachers destroy evidence before or soon after killing a marked animal, then the situation changes entirely. We refer to these occasions as "cryptic poaching." Destruction of evidence is rarely, if ever, associated with nonhuman causes of death. We examine the many factors that may lead to an unknown fate in Supplementary Data SD1, but in the section below, we focus on cryptic poaching. We treat cryptic poaching as an event with estimable frequency. Attempting to estimate the causes of death of the unknown fates can be important if poachers commonly destroy evidence or poaching is common. Therefore, we present approaches to confront that challenge in estimation.

First, we consider and reject 2 extreme approaches to estimating the expected values in Table 1B and P for cryptic poaching. By rejecting the extreme approaches, we clarify the more credible intervals around the values of interest. One extreme approach inspired by cryptic poaching might be to apportion all the unknown fates to other human causes in Table 1B and none to nonhuman causes, assuming that unknown fates only arise from a human destroying evidence. That approach certainly exaggerates poaching, because technology failure, and marked animals that elude monitoring but later die of nonhuman causes, can lead to some disappearances (Supplementary Data SD1). Likewise, the alternative extreme would apportion all unknown fates to nonhuman causes and none to other human causes. That assumption requires more evidence to reject, which we present in Supplementary Data SD1. Nevertheless, the extreme (no cryptic poaching) is illogical by our definition of an animal that eludes monitoring. That some marked animals live and die unmonitored is likely, but eluding monitoring does not immunize animals from poaching unless all poachers avoid marked animals. That seems infeasible if traps, poison, or shooting under conditions of low visibility occur. Therefore, the second extreme approach is also unrealistic. We assume cryptic poaching occurs and we present 2 reasonable approaches to estimate the expected values in Table 1B.

One reasonable approach to estimate cryptic poaching would be to estimate $Expected_{non}$ (the number of marked animals of unknown fate expected to die from nonhuman causes) and $Expected_{oh} + P$ (the number of marked animals of unknown fate expected to die from other human causes) by their relative proportions in the known fates, but importantly, excluding legal kills from that calculation. This "equal apportionment approach" perpetuates the assumption that known fates can be extrapolated to unknown fates without further correction than performed in Table 1A. Equal apportionment is appropriate to situations in which 3 criteria are met: 1) marked animals were selected randomly from the population as a whole, 2) marked animals disappear without regard to the cause of death, and 3) the researchers have evidence that marking and monitoring do not affect risk of different causes of death. We predict these conditions will never be met for controversial wildlife, such as wolves, but we provide the approach for other species and for Bayesian modelers who wish to define informative credible intervals. Figure 2A depicts the equal apportionment approach.

If cryptic poaching is non-zero, then poached animals should be deducted from m before equal apportionment occurs, because poachers interrupted monitoring. Cryptic poaching alters estimates of mortality risk because data are lost; more so as concealment behavior spreads or becomes more effective. We have 2 published estimates of cryptic poaching rates to draw upon. For Scandinavian wolves, the cryptic poaching rate was estimated at 66% of total poaching, suggesting that for each observed poached wolf, 2 poached wolves eluded observation (Liberg et al. 2012). For Wisconsin wolves, the corresponding estimate

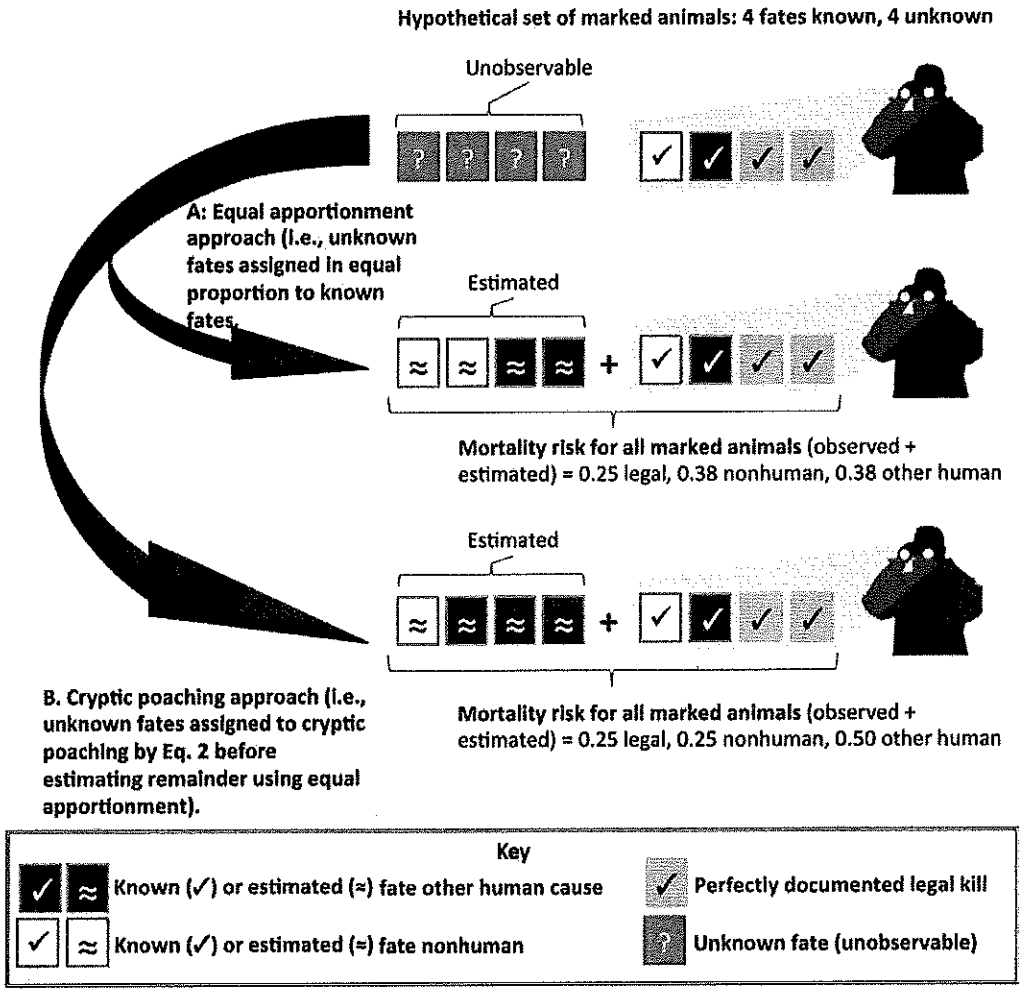

Fig. 2.—Systematic bias in estimating the risk of mortality when some marked animals have unknown fates (unobservable, question marks ?) and causes of death vary in the accuracy of documentation. Observed (silhouette with binoculars) known fates (check marks ✓) alone would underestimate the inaccurately documented causes of death (unknown fates, white, black, and blue squares). Two approaches to estimating unknown fates produce lower and upper bounds on estimates of risk of mortality, using equations 1a, 1b, and 2. A) The equal apportionment approach assumes that the observed ratio of known nonhuman causes of death (white squares with check marks) to known, other human causes of death (black squares with check marks) applies to the unknown fates (squares with approximately equal signs, ≈). B) The cryptic poaching approach with $C = 2$ from equation 2 assumes that for every 1 known-fate poached animal (black square with check mark) there will be 2 unknown-fate poached animals (black square with ≈), which must be accounted first before equal apportionment of the remainder adds 1 poached and 1 nonhuman cause of death (white square with ≈). This approach requires discrimination between poaching and vehicle collision or other unintentional human causes (see Supplementary Data SD2).

was 46–54% of total poaching (Treves et al. 2017b), or for each observed poached wolf, 1 poached wolf eluded observation (Fig. 2B). In Supplementary Data SD1, we explain why the Wisconsin estimate is conservative. In brief, it treats poaching that was known as if there was no attempt at cryptic poaching. Estimates of cryptic poaching are probably landscape-specific and perhaps specific to certain years because they may reflect accessibility to habitat, human attitudes toward current policy, reporting animal deaths, etc. To isolate poaching from other human causes of death for Figs. 2B and 3, we accepted the official estimates of known-fate poaching and vehicle collisions and applied their ratio to our estimates of other human causes in Table 1B (see Supplementary Data SD2 for the raw data). Then, we used 2 equations to estimate the numbers of marked animals of unknown fates expected to die from nonhuman causes and other human causes respectively, as follows:

$$Expected_{non} = (m - P) \bullet Observed_{non} / (Observed_{non} + Observed_{oh}) \quad (1a)$$

$$Expected_{oh} = (m - P) \bullet Observed_{oh} / (Observed_{non} + Observed_{oh}) \quad (1b)$$

where n and m are defined above and in Table 1A, *Legal* is the number of marked animals killed legally, $Observed_{non}$ is the number of marked animals of known fate that died from nonhuman causes, $Observed_{oh}$ is the number of marked animals of known fate that died from human causes other than legal killing, and P is defined by equation 2:

$$P = Poached_{o} \bullet C \quad (2)$$

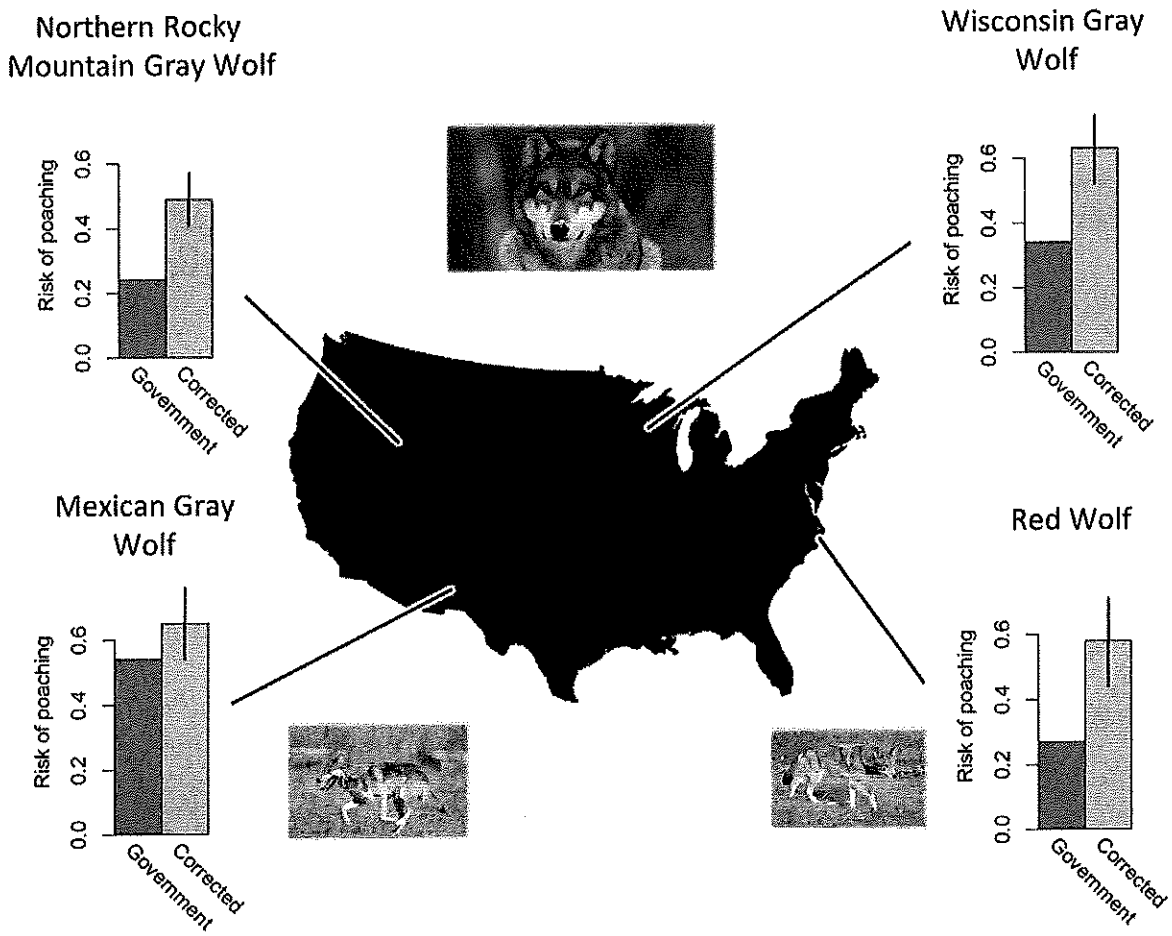

Fig. 3.—Endangered wolves (gray: *Canis lupus*, Mexican gray: *C. l. baileyi*, and red: *C. rufus*) and risk of mortality from poaching as a proportion of all deaths. Approximate geographic locations are shown for 4 populations in the United States. The relative risks of mortality from poaching by government estimates (dark gray bars, no uncertainty estimates available) are paired with the same estimates from this study (light gray bars; error bars: lower bound derived from the equal apportionment approach and upper bound derived from the Scandinavian estimate of cryptic poaching $C = 2$). See Supplementary Data SD2 for poaching values separated from other human causes: Wisconsin (Natural Resources Board 2012); Northern Rocky Mountain (NRM): (Murray et al. 2010; Smith et al. 2010); Mexican: (USFWS 2015: table 4); red (USFWS 2007: figure 7).

where $Poached_o$ is the number of marked animals of known fate that died from poaching and C is the scalar of cryptic poaching, which we assigned the values of 0 (equal apportionment), 1 (Wisconsin estimate), or 2 (Scandinavian estimate) as explained above.

Results

Section 1: overestimating risk for perfectly documented causes of death.—Estimating relative risk of mortality from legal causes using only the known fates produced estimates that were 0.05–0.16 higher than when unknown fates were included (Table 2). Published estimates of the risk of legal killing also tend to be higher than ours in Table 2. For Wisconsin wolves, Stenglein et al. (2015) reported 0.125 risk for "*Legal*" (their Table 2), which was 0.063 higher than our estimate for the same period. For NRM wolves, Smith et al. (2010) reported 0.30 risk of mortality from "legal causes," which is 0.06 higher than our estimate of the risk of mortality from legal causes for the same period. Disparities were not so clear for Mexican and red wolves. Because the USFWS reported mortality risk for Mexican wolves after excluding most legal causes (USFWS 2016c), their proportions are not directly comparable to ours. For red wolves, the USFWS and (Murray et al. 2015) estimated risk as we did (USFWS 2007) citing Murray unpublished. However, disparities between the 2 reports for red wolves could not be reconciled so we used the median which was 0.05 higher than our estimate in Table 2. The overestimates of legal killing in Table 2 increased from 0.05 to 0.16 as the risk of legal killing rose (Fig. 1B).

Section 2: underestimating risk for inaccurately documented causes of death.—Complementary to overestimates of legal killing, estimates of the relative risk of other human-caused mortality using known fates produced lower estimates than when unknown fates were included (Figs. 2A and 2B; Table 3). Official estimates of other human causes of mortality for Wisconsin wolves (Natural Resources Board 2012; Stenglein et al. 2015) were 0.17–0.36 lower than ours in Table 3. The official estimates of risk of mortality from other human causes for NRM wolves from Murray et al. (2010) and Smith et al. (2010)

Table 2.—Relative risk of mortality from legal killing, as a proportion of all radiocollared wolves (*Canis lupus* or *C. rufus*) that had known fates or unknown fates (disappeared or unknown cause of death) for 4 wolf populations with n (number of known fates), m (number of unknown fates), and *Legal* (number of marked animals killed legally). NRM = Northern Rocky Mountains.

Population[a]	Known fates (n)	Unknown fates (m)[b]	Known + unknown fates ($n + m$)[b]
Wisconsin gray	0.12	0	0.06
NRM gray	0.40	0	0.24
Mexican gray	0.33	0	0.25
Red	0.13	0	0.08

[a]Wisconsin 1979–2012 $n = 221$, $m = 210$, *Legal* = 27 (Treves et al. 2017b) from their Table 2; NRM 1982–2004 $n = 320$, $m = 206$, *Legal* = 128 (Murray et al. 2010) from their Table 2; Mexican 1998–2015 $n = 155$, $m = 53$ (8 unknown, 6 awaiting necropsy, 39 lost signals), *Legal* = 51 (including permanent removals, and "Other causes of death include capture-related mortalities and legal shootings by the public"), from USFWS (2015); Siminski (2016); USFWS (2016a, 2016c, 2016b, 2016d); North Carolina red wolves 1999–2007 $n = 111$, $m = 55$, *Legal* = 22 "management" (USFWS 2007) citing Murray, unpublished; however, Murray et al. (2015) reported $n = 91$, $m = 58$, *Legal* = 5. We report the median of the 2 red wolf values.
[b]Because legal kills must be reported (known fates) or they are not legal, the corrected risk of legal killing followed the method in Table 1A and Fig. 1A.

Table 3.—Relative risk of mortality from inaccurately documented causes of death, as a proportion of all radiocollared wolves (*Canis lupus* or *C. rufus*) that had known fates or unknown fates (disappeared or unknown cause of death) for 4 wolf populations: n (number of known fates), m (number of unknown fates), $Observed_{oh}$ (number of marked animals of known fate that died from human causes other than legal killing), $Expected_{oh}$ (the number of marked animals of unknown fate expected dead from other human causes), C is the cryptic poaching scalar of 0, 1, or 2, and P is the number of marked animals of unknown fate expected dead from cryptic poaching following equation 2. NRM = Northern Rocky Mountains.

Populations and estimation approaches (C)[a]	$Observed_{oh}/n$	$(Expected_{oh} + P)/m$	Weighted average
Wisconsin equal apportionment (0)	0.57	0.65	0.60
Wisconsin cryptic poaching (1, 2)	0.57	0.80, 0.95	0.68, 0.75
NRM equal apportionment (0)	0.37	0.61	0.46
NRM cryptic poaching (1, 2)	0.37	0.77, 0.94	0.53, 0.59
Mexican equal apportionment (0)	0.52	0.77	0.59
Mexican cryptic poaching (1, 2)	0.52	1.05, 1.33[d]	0.66, 0.73
Red equal apportionment (0)	0.65	0.74	0.68
Red cryptic poaching (1, 2)	0.65	0.94, 1.13[d]	0.75, 0.82

[a]Sources are identical to Table 2 and raw data are found in Supplementary Data SD2. We used the median of the 2 red wolf values: $Poached_u = 45$ ("Private Trap," "Poison," "Gunshot"[b]) or 39 ("Gunshot," "illegal"[c]), $Observed_{oh} = 23$ for both sources[b,c], comprising 0.76[b] or 0.72[c] of $n - Legal = 90$[b] or 86[c], as the number of marked animals killed legally.
[b]USFWS (2007).
[c]Murray et al. (2015).
[d]Values exceeding 1.0 arose when equation 2 yielded a higher value than m.

were 0.14–0.27 lower than ours in Table 3. The official estimate of risk of mortality from other human causes for Mexican wolves was 0.07–0.21 lower than ours in Table 3, when calculated with all deaths and permanent removals (USFWS 2016c). The median of the 2 estimates of risk of mortality from other human causes for red wolves was 0.26–0.40 lower than ours in Table 3. Even with the conservative equal apportionment approach, our ranges of estimates all fall above official point estimates made by agencies and biologists.

Poaching in particular has been underestimated systematically by biologists and policy makers (Fig. 3). In Fig. 3, we present the official estimates of poaching for 4 endangered wolf populations in the United States, compared to our range of estimates from Table 3 and Supplementary Data SD2. Using the Wisconsin estimate of cryptic poaching (50%), our estimates of risk of mortality from poaching are 0.17–0.32 higher than official estimates of the risk of mortality from poaching. The Scandinavian estimate of cryptic poaching (66%) yielded estimates of risk of mortality from poaching that are 0.32–0.45 higher than official estimates of the risk of mortality from poaching. The Wisconsin estimate of cryptic poaching lies near, but slightly higher, than the median between the equal apportionment lower bound (Fig. 2A) and the Scandinavian cryptic poaching upper bound (Fig. 2B), which suggests slightly asymmetrical credible intervals because of negative skew.

Supplementary Data SD3 presents our estimates of risk of mortality for 3 causes of death (see Supplementary Data SD2). Poaching was the major cause of death for the 4 endangered wolf populations.

Discussion

The relative risks of different causes of death for marked animals have often been miscalculated under 1 or both of the following common conditions: 1 or more causes of death were perfectly reported but others were not, or marked animals had unknown fates (i.e., disappeared without a trace or were recovered but the cause of death was undetermined). The resulting bias overestimates the perfectly reported causes of death, such as legal killing, and underestimates the others, such as

poaching. With evidence from 4 endangered wolf populations in the United States, we showed the miscalculation biased estimates substantially upwards for legal killing and biased them substantially downwards for other human causes (mainly poaching and vehicle collisions; Fig. 3 and Supplementary Data SD3). The error is non-random (systematic bias) and will increase under several common conditions: high rates of legal killing (Fig. 1B), high proportions of unknown fates (Fig. 2A), and high rates of cryptic poaching (i.e., unreported killing associated with destruction of evidence; Fig. 2B).

The corrections we applied, under even the most conservative equal apportionment approach, yielded estimates indicating that unregulated human-caused mortality was the major cause of death in endangered wolf populations in the United States (Supplementary Data SD3). Observed poaching in all the populations we studied outnumbered the primary other human cause of death, vehicle collisions, by a factor of 2 or more. That means most of the underestimation of other human causes was due to underestimating poaching. When we corrected the bias, we found substantial underestimates of poaching (Fig. 3). Indeed, for every wolf population we examined, we found poaching was the greatest threat. In the NRM wolf populations from 1982 to 2004, poaching replaced legal killing as the major threat to wolves after correcting for the mathematical miscalculation of legal killing. For the other wolf populations, the official reports had correctly identified poaching as the major threat, although they underestimated it.

There are several reasons our estimates of poaching are higher than previous ones. First, we demonstrated that prior estimates would have underestimated causes of death that are not perfectly documented. Second, we took 2 approaches to reconstruct the unknown fates of radiocollared wolves. The first approach, equal apportionment, assumes unmonitored wolves die of the same fates at the same rates as monitored wolves. This is unlikely to hold in any population of marked animals, let alone controversial ones such as wolves that are subject to high relative risks of legal and illegal killing. As such, the equal apportionment approach should be seen as a minimum bound on estimates of the risk of mortality from poaching. By contrast, we provided maximum bounds on the estimated risk of mortality from poaching, when we used the cryptic poaching approach, which apportions unknown fates to cryptic poaching first, informed by prior estimates of cryptic poaching from the literature. We used 2 published values for cryptic poaching from the literature (50% and 66%) and found the higher one probably too high (Table 3 footnote d). Accordingly, we recommend the 50% cryptic poaching estimate be used as the median for the likely range of values to estimate the risk of wolf mortality from poaching. These values and approaches may need adjustment for other sites and other species.

The traditional assumption that the causes of death in individuals of known fate are representative of those of unknown fate is inaccurate whenever known fates include both perfectly documented and inaccurately documented causes of death. The bias increases in proportion to the number of legal kills and the number of unknown fates because each one adds additional bias (overrepresenting perfectly documented causes of death and underrepresenting inaccurately documented causes of death, respectively). By accounting fully for all marked animals and by estimating the unknown fates, we can extract more information from the sample of marked animals than has been done traditionally. Extracting more information is desirable from the standpoint of management efficiency (less effort to mark animals is wasted when data are lost) and also for accuracy.

Some authorities will dismiss relative risk estimates as irrelevant for populations perceived to be large, growing, and resilient. Such a dismissal might be biologically inappropriate. Three studies of gray wolves, 1 in Wisconsin and 2 separate populations in Alaska (Schmidt et al. 2015; Borg et al. 2016; Treves et al. 2017b), demonstrate that mortality rates (per capita hazard) for marked wolves were as different as 15–28% from the per capita hazard rate for unmarked wolves. A mechanistic link between mismeasured risk and unrepresentative hazard rates for marked animals might exist. For example, it might relate to the methods used in recent years to mark wolves, such as livetrapping in areas where few people spend time or livetrapping in core areas of established wolf pack territories, both of which may capture individuals with lower exposure to human-caused mortality (Treves et al. 2017b). Alternatively, hunters and poachers may be able to target (or avoid) marked wolves with high accuracy, a possibility that has not been studied from the perspective of hunters and trappers, to our knowledge. If marked and unmarked animals experience differential per capita hazard rates, then marked animals will become less representative of the population as the relative risk of human-caused mortality increases. Such a relationship could account for the empirical observations of accelerating declines in wolf population growth as human-caused mortality increases (Adams et al. 2008; Creel and Rotella 2010; Vucetich 2012).

Pending further study, we advise against extrapolation from data on haphazardly marked animals of any species. Moreover, one should not discard the lost data from marked animals of unknown fate as is common in wildlife mortality analyses (Liberg et al. 2012). We recommend governments and researchers report data on marked and unmarked animals transparently, including "time on the air" for telemetry data. Additionally, spatial variation in human density and activity across the range of marked animals might be useful when poaching is a major cause of death for study subjects. Together, such steps would improve estimates of mortality parameters for marked animals and, consequently, help to avert policy errors.

Acknowledgments

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Supplementary Data

Supplementary data are available at *Journal of Mammalogy* online.

Supplementary Data SD1.—Disappearances of marked animals.

Supplementary Data SD2.—Data for calculations in Tables 2 and 3, and Supplementary Data SD3.

Supplementary Data SD3.—Revised estimates of risk for each category of cause of death in endangered wolf populations in the United States.

Literature Cited

Adams, L. G., R. O. Stephenson, B. W. Dale, R. T. Ahgook, and D. J. Demma. 2008. Population dynamics and harvest characteristics of wolves in the Central Brooks Range, Alaska. Wildlife Monographs 170:1–25.

Bangs, E. E., and S. H. Fritts. 1996. Reintroducing the gray wolf to central Idaho and Yellowstone National Park. Wildlife Society Bulletin 24:402–413.

Borg, B. L., et al. 2016. Implications of harvest on the boundaries of protected areas for large carnivore viewing opportunities. PLoS One 11:e0153808.

Creel, S., and J. J. Rotella. 2010. Meta-analysis of relationships between human offtake, total mortality and population dynamics of gray wolves (*Canis lupus*). PLoS One 5:1–7.

Liberg, O., G. Chapron, P. Wabakken, H. C. Pedersen, N. T. Hobbs, and H. K. Sand. 2012. Shoot, shovel and shut up: cryptic poaching slows restoration of a large carnivore in Europe. Proceedings of the Royal Society of London, B. Biological Sciences 270:91–98.

McLellan, B. N., et al. 1999. Rates and causes of grizzly bear mortality in the Interior Mountains of British Columbia, Alberta, Montana, Washington, and Idaho. Journal of Wildlife Management 63:911–920.

Murray, D. L., G. Bastille-Rousseau, J. R. Adams, and L. P. Waits. 2015. The challenges of rRed wolf conservation and the fate of an endangered species recovery program. Conservation Letters 8:338–344.

Murray, D. L., et al. 2010. Death from anthropogenic causes is partially compensatory in recovering wolf populations. Biological Conservation 143:2514–2524.

Natural Resources Board. 2012. Adoption of Board Order WM-09012(E) relating to wolf hunting and trapping regulations, establishment of a depredation program, and approval of a harvest quota and permit level (Natural Resources Board, ed.). Wisconsin Department of Natural Resources, Madison.

Newcomer, E., M. Palladini, and L. Jones. 2011. The Endangered Species Act v. the United States Department of Justice: how the Department of Justice derailed criminal prosecutions under the Endangered Species Act. Animal Law 17:241–271.

Schmidt, J. H., D. S. Johnson, M. S. Lindberg, and L. G. Adams. 2015. Estimating demographic parameters using a combination of known-fate and open N-mixture models. Ecology 56:2583–2589.

Siminski, P. 2016. Mexican Wolf *Canis lupus baileyi* International Studbook. The Living Desert, Palm Desert, California.

Smith, D. W., et al. 2010. Survival of colonizing wolves in the Northern Rocky Mountains of the United States, 1982–2004. Journal of Wildlife Management 74:620–634.

Stenglein, J., et al. 2015. Mortality patterns and detection bias from carcass data: an example from wolf recovery in Wisconsin. Journal of Wildlife Management 7:1173–1184.

Treves, A., et al. 2017a. Estimating poaching opportunity and potential. Pp. 197–212 in Conservation criminology (M. L. Gore, ed.). John Wiley & Sons, New York.

Treves, A., J. A. Langenberg, J. V. López-Bao, and M. F. Rabenhorst. 2017b. Gray wolf mortality patterns in Wisconsin from 1979 to 2012. Journal of Mammalogy 98:17–32.

Treves, A., and K. A. Martin. 2011. Hunters as stewards of wolves in Wisconsin and the Northern Rocky Mountains, USA. Society and Natural Resources 24:984–994.

Treves, A., L. Naughton-Treves, and V. S. Shelley. 2013. Longitudinal analysis of attitudes toward wolves. Conservation Biology 27:315–323.

USFWS. 2007. Red Wolf (*Canis rufus*) 5-year status review: summary and evaluation. https://ecos.fws.gov/docs/five_year_review/doc3991.pdf. Accessed 5 March 2017.

USFWS. 2015. Mexican Wolf Recovery Program: progress report #17. U.S. Fish & Wildlife Service, Albuquerque, New Mexico.

USFWS. 2016a. 2015 Mexican Wolf Population Survey reveals more work to be done but strategy remains viable. U.S. Fish & Wildlife Service, Albuquerque, New Mexico.

USFWS. 2016b. Mexican Wolf Experimental Population Area (MWEPA) Monthly Project Updates September 2016. U.S. FIsh & Wildlife Service, Albuquerque, New Mexico.

USFWS. 2016c. Mexican Wolf Recovery Area Statistics. U.S. Fish & Wildlife Service, Albuquerque, New Mexico.

USFWS. 2016d. Outcomes of Mexican wolf management removals from the Mexican Wolf Recovery Area Populationa, Arizona and New Mexico, 1998–2015). U.S. Fish & Wildlife Service, Albuquerque, New Mexico.

Vucetich, J. A. 2012. Appendix: the influence of anthropogenic mortality on wolf population dynamics with special reference to Creel and Rotella (2010) and Gude *et al.* (2011) in the Final peer review of four documents amending and clarifying the Wyoming gray wolf management plan. Congressional Federal Register 50:78–95.

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Supplementary Data S1.—Disappearances of marked animals

Animals elude monitoring for a variety of reasons. One of the best-understood reasons is the failure of transmitters, batteries, or collars. VHF technology is generally the most reliable telemetry method (Mech and Barber-Meyer 2002), but the technology can still fail. A recent comparison of five manufacturers quantified reliability (Habib et al. 2014): ATS (100% reliable), Wildlife Materials (96%), Telonics (86%), AVM Instruments (58%), and HABIT (39%). The maker of radio-collars was not specified in the government reports we analyzed nor could we find a reference to which brands were sold or deployed most commonly to United States governments. In our experience, the most common brands were ATS, Wildlife Materials, and Telonics. Therefore, we assume an overall 6% failure rate from the average of the three brands as measured by (Habib et al. 2014). We use that value qualitatively below.

Once a marked animal eludes monitoring, the animal may die from any cause, some of which might entail concealment of evidence. Even poaching with no intent to conceal evidence can result in lost data from marked animals that eluded monitoring. For example, in Wisconsin, it was legal to kill a coyote in many locations most of the year without reporting the kill, so it is conceivable that a wolf that had eluded monitoring was killed under mistaken identity by a poacher who did not retrieve the carcass and therefore did not detect the collar. Therefore, technology failure creates detection bias for death from many causes. In addition, some marked animals may elude monitoring if transmitters fail after vehicle collisions, chewing by other animals, or natural causes that bury or damage a transmitter. We cannot at present estimate the frequencies of such events, but again, detection bias is added to a death from any of the typical causes that are

not perfectly documented. Therefore, the values in Tables 1B and 3 for $Expected_{non}$ and $Expected_{oh}$ contain instances of technology failure. Our assumption above about a 6% technology failure rate and our assumption that collars fail under other circumstances but very rarely suggests that unknown fates should be rare without additional reasons for disappearances of marked animals. Put another way, Supplementary Data S2 and Table 2 reveal that one-third to one-half of marked, radio-collared wolves disappeared. The disparity between that range of values and 6% suggests another reason exists for the disappearances of marked wolves.

That leaves us to consider cases in which an animal eluded monitoring but its technology did not fail. The effort invested in monitoring in both time and area covered would presumably affect the probability that an animal eludes monitoring for long enough to be classified as unknown fate. For example, Wisconsin wolf monitors seemed to stop searching for a missing radio-signal after a few months at most of medium-altitude aerial telemetry (Treves et al. 2017), whereas NRM wolf monitors appeared to use high-altitude aerial telemetry over a wider area (Smith et al. 2010). We are not aware of quantifications of the effort expended or rate of return per unit effort in those two studies. Neither Murray et al. (2010) nor Smith et al. (2010) quantified how many marked NRM wolves eluded monitoring but were found later by other means. Presumably, such values are site-specific and perhaps time-specific By contrast, in Wisconsin, 26% of the marked wolves that had eluded monitoring were later found dead; and found by other means than telemetry. Conversely, 74% of marked wolves eluded monitoring and were never recovered. Further examination of the Wisconsin data suggests the reporting rates for marked wolves that had eluded monitoring but were found dead by other means

varied by cause of death. Treves et al. (2017) estimated the reporting rate at 17% for nonhuman causes and 50% for vehicle collisions (Treves et al. 2017). Presumably, deaths on roads were associated with a 33% higher reporting rate because the driver or subsequent passers-by reported the collared carcass to monitors. Therefore, Treves et al. (2017) predicted that the corresponding reporting rate for poached, marked wolves would be lower than that associated with vehicle collisions. Indeed, their reconstruction of unknown fates led to an estimate of reporting rate for poached, marked wolves of 18% (Treves et al. 2017). The similarity of this reporting rate to that for nonhuman causes suggests that recovering marked wolves that eluded monitoring in Wisconsin was as difficult for poached wolves as for those that died of nonhuman causes. We predict therefore that cryptic poaching occurs in areas with low human use (unlike roads).

Inferences about unknown fates of marked animals hinge critically on careful consideration of detection bias and reporting bias. Our method in Table 1B contains an implicit hypothesis about the accuracy of documentation for different causes of death. The three categories of cause of death vary from perfectly documented to two different forms of incomplete documentation (inaccuracy). The first category is legal killing, (reporting bias = 0 and detection bias = 0). The second category includes causes of death that were unrelated to human action, but the monitors lose information because the death is not detected by the same method as known fates (e.g., telemetry). The result is detection bias. The third category includes causes of death that involve humans (i.e., the deaths were detected), yet the monitors lose information because the deaths were not reported (i.e., reporting bias plus detection bias). Reporting bias can arise from concealment of evidence (cryptic poaching or unintentional lack of reporting). For

example, a person may be unaware they have killed a marked animal, including vehicle collisions at high speed or in poor light, weapons that lead to death long after an encounter, or mistaken identity between species. All these could stymie reporting of a dead marked animal, even by a person who intends to report or has a permit to kill that animal (Newsome et al. 2015; Treves et al. 2017). Regardless, the animal in those cases ends up as an unknown fate due to reporting bias.

Cryptic poaching is non-zero.—Analysis of 'time on the air' for radio-collared Wisconsin wolves revealed that the average interval between dates of collaring and disappearance of 534 days (*SD* 767 days) was similar to that for poached wolves (547 days); by contrast, the average intervals for nonhuman causes and vehicle collisions were 679 and 807 days, respectively (Treves et al. 2017). That makes cryptic poaching seem probable for many unknown fates, although circumstantially. Additionally, veterinary pathology information from necropsy and radiography for some Wisconsin wolves revealed that poaching was missed in 6–37% of cases (depending on which subsets of carcasses were considered), even for ostensibly known fates. One cannot extrapolate from these percentages because the samples were not random, but one can infer that measurement of known fates was biased low for poaching (Treves et al. 2017). Prior and concurrent work on Wisconsin wolf mortality did not report these and other biases (Wydeven et al. 2001; Stenglein et al. 2015). If such measurement errors arise beyond Wisconsin, then the nonhuman causes among known fates contain more poached wolves than the converse.

Among the NRM wolves, the median and average time to disappearance were 96% and 104% of the median and average time to known fates respectively (Smith et al.

2010). They did not provide these data by cause of death but technology failure would seem an unlikely explanation for so many disappearances with similar timing.

Liberg et al. (2012) also presented evidence for suspicious disappearances of marked wolves from an almost completely closed population that was monitored intensively with telemetry and genetic fingerprinting.

Finally, abundant anecdotal claims about poaching and concealing evidence pervade the literature on wolves (reviewed in (Browne-Nuñez et al. 2015). In sum, it is highly unlikely that unknown fates are either all poaching or all non-poaching.

Literature Cited

Browne-Nuñez, C., A. Treves, D. Macfarland, Z. Voyles, and C. Turng. 2015. Tolerance of wolves in Wisconsin: A mixed-methods examination of policy effects on attitudes and behavioral inclinations. Biological Conservation 189:59–71.

Habib, B., S. Shrotriya, K. Sivakumar, P. R. Sinha, and V. B. Mathur. 2014. Three decades of wildlife radio telemetry in India: a review. Animal Biotelemetry 2:4:DOI: 10.1186/2050-3385-1182-1184.

Mech, L., and S. M. Barber-Meyer. 2002. A critique of wildlife radio-tracking and its use in National Parks). U.S. National Park Service, Fort Collins, CO.

Murray, D. L. et al. 2010. Death from anthropogenic causes is partially compensatory in recovering wolf populations. Biological Conservation 143:2514–2524.

Newsome, T., J. T. Bruskotter, and W. J. Ripple. 2015. When shooting a coyote kills a wolf: Mistaken identity or misguided management? Biodiversity and Conservation 24:3145-3149.

Smith, D. W. et al. 2010. Survival of colonizing wolves in the Northern Rocky Mountains of the United States, 1982 – 2004. Journal of Wildlife Management 74:620 – 634.

Stenglein, J., T. R. Van Deelen, A. P. Wydeven, D. J. Mladenoff, J. Wiedenhoeft, J. A. Langenberg, and N. J. Thomas. 2015. Mortality patterns and detection bias from carcass data: An example from wolf recovery in Wisconsin. Journal of Wildlife Management 7:1173-1184.

Treves, A., J. A. Langenberg, J. V. López-Bao, and M. F. Rabenhorst. 2017. Gray wolf mortality patterns in Wisconsin from 1979 to 2012. Journal of Mammalogy 98:17-32.

Wydeven, A. P., D. J. Mladenoff, T. A. Sickley, B. E. Kohn, R. P. Thiel, and J. L. Hansen. 2001. Road density as a factor in habitat selection by wolves and other carnivores in the Great Lakes Region. Endangered Species Update 18:110-114.

Supplementary Data S2.ÐÐData for calculations in Tables 2, 3, and Supplementary Data S3

Wolf populatic	Deaths	Equal apportionment approach			Cryptic poaching approaches					
	Known	Unknown C = Known + Unk		Risk	Unknown C = Unknown risk		Risk	Unknown C = Unknown risk		Risk
Wisconsin tot	221	210	431	1	210	1	431	210	1	431
Legal	27	0	27	0.06	0	0	0.06	0	0	0.06
Nonhuman	69	75	144	0.33	43	0.2	0.26	11	0.05	0.18
Other human	125	135	260	0.6	167	0.8	0.68	199	0.95	0.75
Pa		0			90			180		
NRM total	320	206	526	1	206	1	526	206	1	526
Legal	128	0	128	0.24	0	0	0.24	0	0	0.24
Nonhuman	75	80	155	0.3	46	0.23	0.23	13	0.06	0.17
Other human	117	126	243	0.46	160	0.77	0.53	194	0.94	0.59
Pa		0			87			174		
Mexican total	155	53	208	1	53	1	208	53	1	208
Legal	51	0	51	0.25	0	0	0.25	0	0	0.25
Nonhuman	23	12	35	0.17	-3	-0.05	0.1	-17	-0.33	0.03
Other human	81	41	122	0.59	56	1.05	0.66	70	1.33	0.73
Pa		0			66			132		
Red 1b total	112	55	167	1	55	1	167	55	1	167
Legal	22	0	22	0.13	0	0	0.13	0	0	0.13
Nonhuman	22	13	35	0.21	2	0.04	0.15	-9	-0.16	0.08
Other human	68	42	110	0.66	53	0.96	0.72	64	1.16	0.79
Pa		0			45			90		
Red 2b total	91	58	149	1	58	1	149	58	1	149
Legal	5	0	5	0.03	0	0	0.03	0	0	0.03
Nonhuman	24	16	40	0.27	5	0.09	0.2	-6	-0.1	0.12
Other human	62	42	104	0.7	53	0.91	0.77	64	1.1	0.84
Pa		0			39			78		

a P = Poached0 ¥ C where Poached0 is the number of marked wolves of known fate that died from poaching; negative values for unknown fates arose if P > m.
b USFWS 2007 (red 1) and Murray et al. 2015 (red 2) reported different values so we use the median in the Main text.

To estimate risk for Figures 3 and Supplementary Data S3 we used the following:

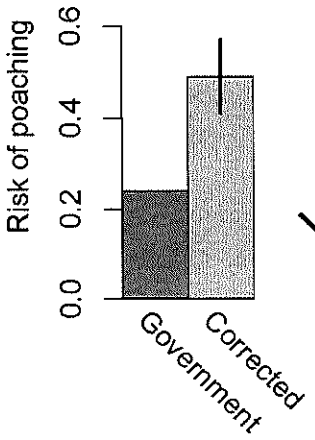
Our estimates	Poached0/ otl	Poaching risk	Vehicle strike	Nonhuman ris	Legal kill risk	Total
Wisconsin up	0.72	0.66	0.09	0.18	0.06	1
lower bound	0.72	0.43	0.17	0.33	0.06	1
median	0.72	0.55	0.13	0.26	0.06	1
NRM upper b	0.74	0.52	0.07	0.17	0.24	1
lower bound	0.74	0.34	0.12	0.3	0.24	1
median	0.74	0.43	0.09	0.23	0.24	1
Mexican uppe	0.81	0.71	0.02	0.03	0.25	1
lower bound	0.81	0.48	0.11	0.17	0.25	1

median	0.81	0.59	0.06	0.1	0.25	1
Red 1 upper t	0.66	0.7	0.08	0.08	0.13	1
lower bound	0.66	0.43	0.22	0.21	0.13	1
median	0.66	0.57	0.15	0.15	0.13	1
Red 2 upper t	0.63	0.72	0.12	0.12	0.04	1.01
lower bound	0.63	0.44	0.26	0.27	0.04	1.01
median	0.63	0.58	0.19	0.2	0.04	1.01

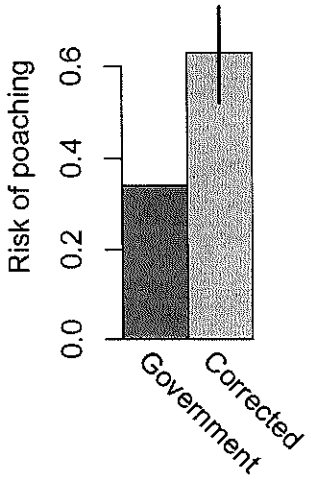
a See Methods in main text for calculations of expected ratios for Eq. 1a,b

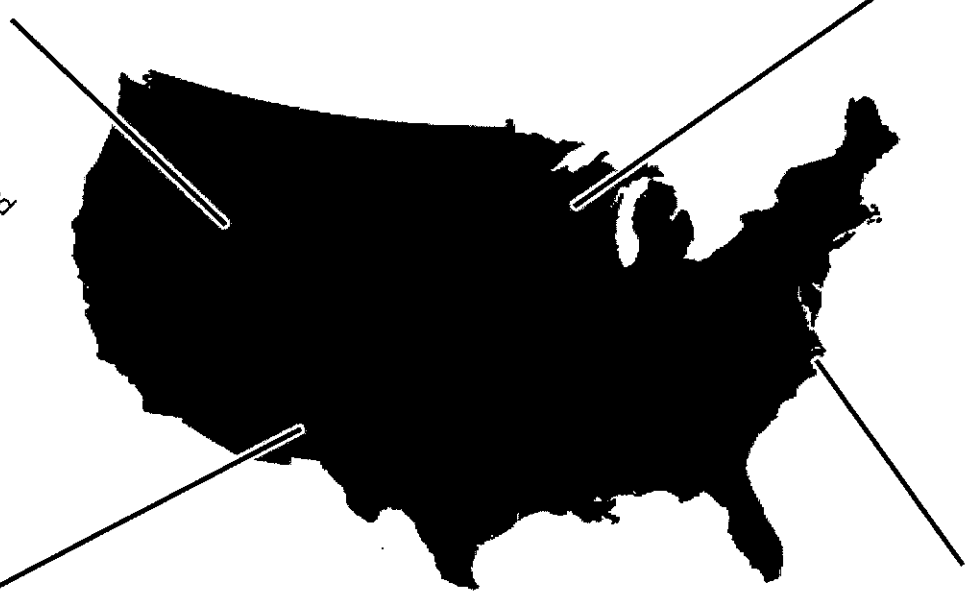
b Vehicle strike or collision could be negative because it was calculated after other causes of death.

Northern Rocky Mountain Gray Wolf

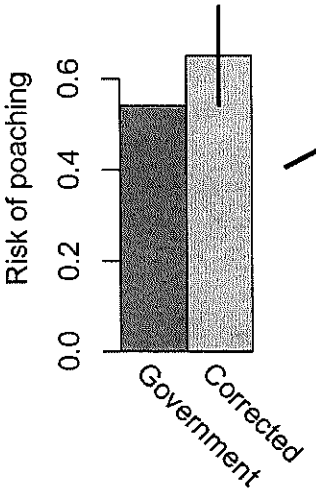


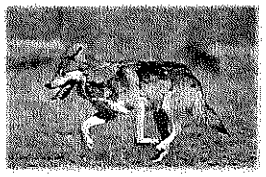
Wisconsin Gray Wolf

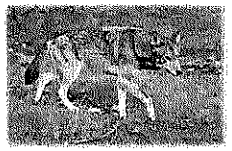




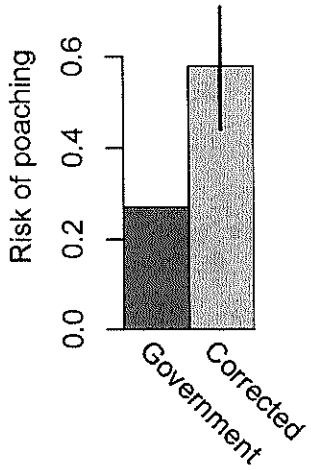
Mexican Gray Wolf







Red Wolf



Mismeasured mortality: correcting estimates of wolf poaching in the United States

Adrian Treves, Kyle A. Artelle, Chris T. Darimont, David R. Parsons. Journal of Mammalogy 2017, in press.

Three sentence summary: Poaching is not something happening only in distant regions, it is the most common cause of wolf mortality in every population where it has been measured accurately. During the period U.S. wolves were listed under the ESA, the relative importance of poaching was systematically and substantially under-estimated while the relative importance of legal causes of mortality was systematically over-estimated. We correct the algebraic errors and errors of inference that led to these biased estimates.

Abstract: Measuring rates and causes of mortalities are important in animal ecology and management. Observing the fates of known individuals is a common method of estimating life history variables, including mortality patterns. It has long been assumed that data lost when known animals disappear were unbiased. We test and reject this assumption under conditions common to most, if not all, studies using marked animals. We illustrate the bias for 4 endangered wolf populations in the United States by reanalyzing data and assumptions about the known and unknown fates of marked wolves to calculate the degree to which risks of different causes of death were mismeasured. We find that, when using traditional methods, the relative risk of mortality from legal killing measured as a proportion of all known fates was overestimated by 0.05–0.16 and the relative risk of poaching was underestimated by 0.17–0.44. We show that published government estimates are affected by these biases and, importantly, are underestimating the risk of poaching. The underestimates have obscured the magnitude of poaching as the major threat to endangered wolf populations. We offer methods to correct estimates of mortality risk for marked animals of any taxon and describe the conditions under which traditional methods produce more or less bias. We also show how correcting past and future estimates of mortality parameters can address uncertainty about wildlife populations and increase the predictability and sustainability of wildlife management interventions.

FAQs

How did mismeasurement of mortality risk escape notice for decades?

There are several ways to study the lives of wild animals. All methods have some uncertainty because wild animals go about their lives far from our scrutiny and may elude our efforts to detect them again. The ultimate cause of death for animals that elude monitoring is rarely known. Scientists call these marked animals unknown fates. Marking animals with radio-collars, as done with most wolves we studied, tends to have even more uncertainty because radio-telemetry technology required lots of human effort to detect marked animals again and because poachers can destroy radio-collars without too much difficulty.

The lead author became interested in what had happened to radio-collared wolves in Wisconsin where many eluded monitoring[1]. The investigation spread to other populations because the authors found the same assumption had been used in other wolf populations. That assumption was the radio-collared wolves with known fates were a fair representation of all wolves. Our paper shows that assumption is misleading whenever people kill wolves legally – because no unknown fate wolves were killed legally. Had they been killed legally, wolves would have been reported and therefore had known fates. Because a sizeable proportion of wolves are killed legally each year during government culling or regulated hunting and trapping, the known fate sample of dead wolves is relatively full of such cases. But the unknown fate dead wolves never die from legal causes. When we set out to investigate what happened to unknown fates in Wisconsin, we did not expect to find a miscalculation that applied to all wolves.

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[1] Treves, A., J. A. Langenberg, J. V. López-Bao, and M. F. Rabenhorst. 2017. Gray wolf mortality patterns in Wisconsin from 1979 to 2012. Journal of Mammalogy 98:17-32.

Last year, Treves and others notified experts on Northern Rocky Mountain wolves that the assumption was flawed[2] and in the ensuing year, the current team of authors investigated red wolves and Mexican wolves to confirm the same phenomenon applied. We now believe our finding applies to all studies of marked animals in which a perfectly reported cause of death occurs alongside imperfectly reported ones. Moreover, for populations with cryptic poaching – in which poachers conceal evidence – the biasing effect of the false assumption will be amplified.

Why does the article state that one error is a mathematical fact? Isn't this a dispute over interpretation of data?

We identified an error that is simply algebraic and an error of estimation that are separate issues. The algebraic mismeasurement is the over-estimation of the risk of legal killing. This should always be calculated as a proportion of all dead animals, not as a proportion of known fates because known fates over-represent legal causes of death by a known amount (Figures 1a,b below).

We also identified an error of inference about the other causes of death. After one corrects the calculation of risk of legal causes of death as above, then one has to confront what might have happened to the unknown fates. These unknown fates have been ignored traditionally, which discards useful information. We therefore presented a method to estimate what happened to those unknown fates. In the case of marked wolves, we show that poaching in particular has been under-estimated because cryptic poaching has not been accounted for properly. We presented two methods to account for cryptic poaching and one method that ignores cryptic poaching (Figures 2a,b below).

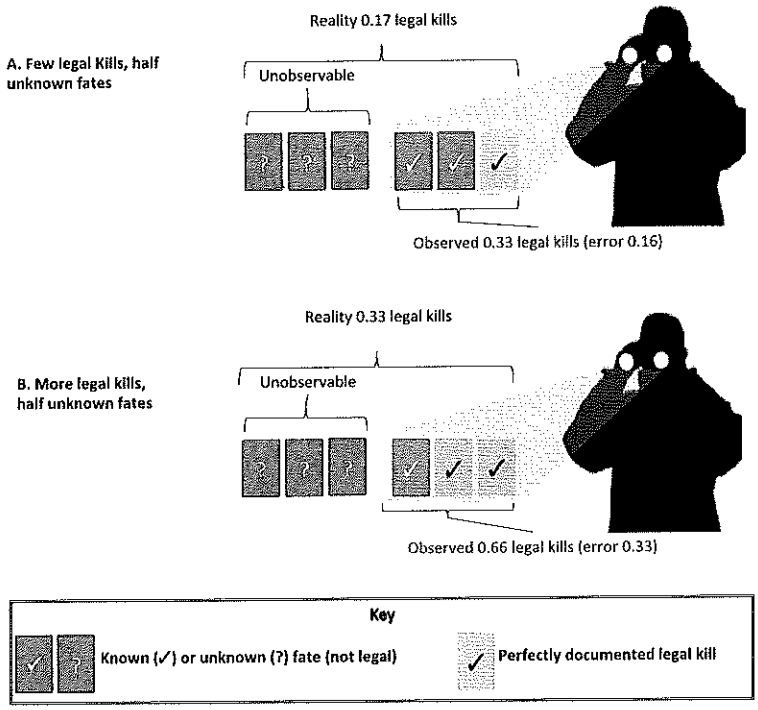


***Fig. 1.**—Systematic bias in calculating the risk of mortality from legal killing when some marked animals have unknown fates (unobservable with question marks ?) and causes of death vary in the accuracy of documentation. The green squares represent legal kills (perfectly documented) and the blue squares denote other causes of death (inaccurately documented). Observed (silhouette with binoculars) known fates (check marks ✓, and calculation in red text) alone would over-estimate the real risk of legal killing. **A:** Positive bias in estimating risk of legal killing is 0.16. **B:** Positive bias increases by 0.17 as the proportion of legal kills increases.*

[2] Treves, A., M. Krofel, and J. V. Lopez-Bao. 2016. Missing wolves, misguided policy. Science (eLetter) 350:1473-1475.

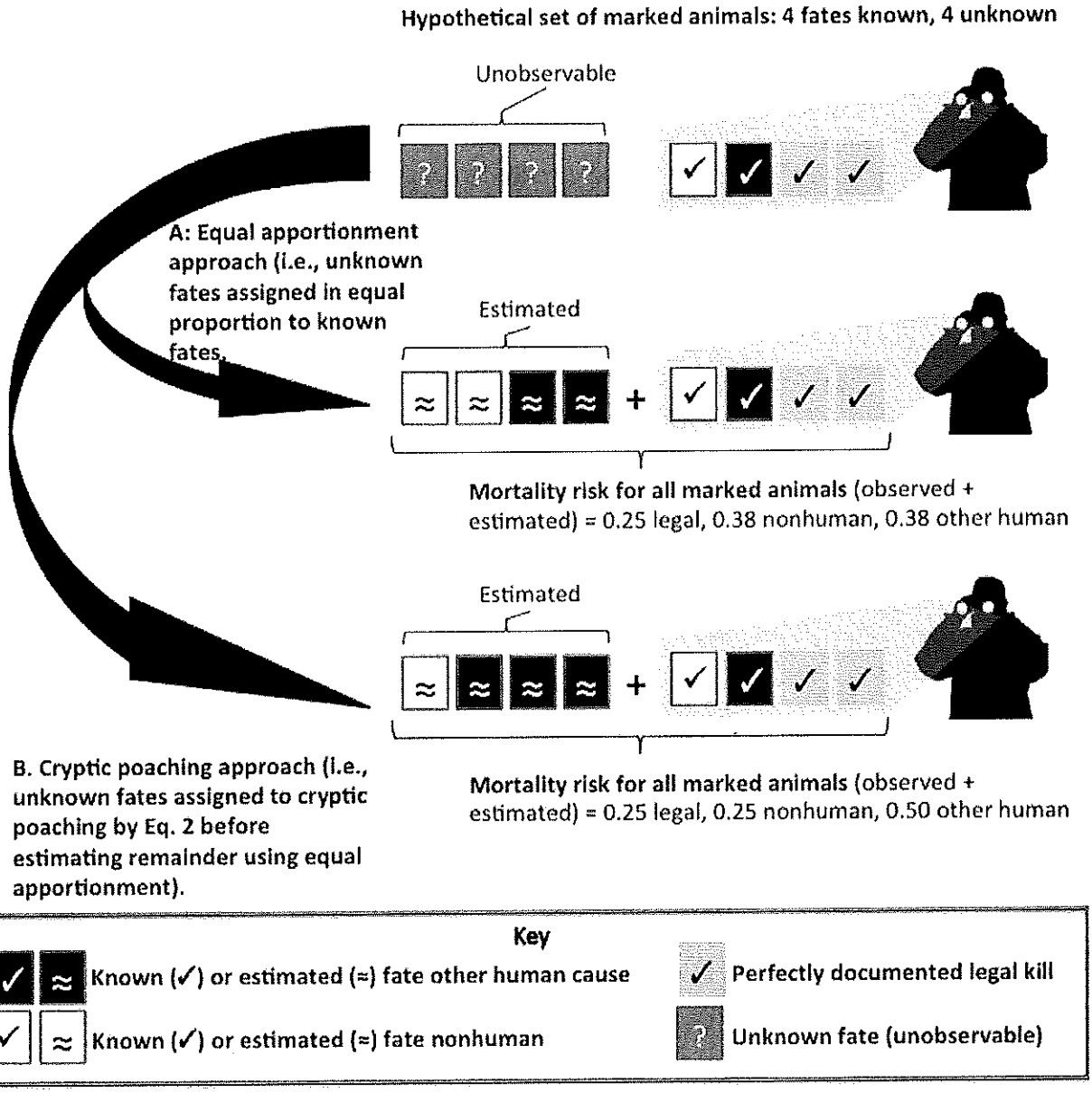


Fig. 2.— *Systematic bias in estimating the risk of mortality when some marked animals have unknown fates (unobservable, question marks ?) and causes of death vary in the accuracy of documentation. Observed (silhouette with binoculars) known fates (check marks ✓) alone would under-estimate the inaccurately documented causes of death (unknown fates, white, black, and blue squares). Two approaches to estimating unknown fates produce lower and upper bounds on estimates of risk of mortality, using Eqs. 1a, b, and 2. A: The equal apportionment approach assumes that the observed ratio of known nonhuman causes of death (white squares with check marks) to known, other human causes of death (black squares with check marks) applies to the unknown fates (squares with approximately equal signs, ≈). B: The cryptic poaching approach with C = 2 from Eq. 2 assumes that for every one known-fate poached animal (black square with check mark) there will be two unknown-fate poached animals (black square with ≈), which must be accounted first before equal apportionment of the remainder adds one poached and one nonhuman cause of death (white square with ≈). This approach requires discrimination between poaching and vehicle collision or other unintentional human causes (see Supplementary Data S2).*

What is the difference between mortality risk and mortality rate?

Mortality risk is the percentage of animals that die from a given cause; collectively all the mortality risks will sum to 100%. For instance, the risk of poaching is the number of dead wolves that died from poaching divided by all the dead wolves, expressed as a percentage or a proportion. Mortality rate by contrast is the number of animals that died in a given time period from an identified group of animals some of which remain alive at the end of the period. Mortality rate is often expressed as a proportion of all marked animals in a given time or as a per capita hazard rate (with a maximum of 1.0 therefore). The possible mix-up between mortality risk and per capita hazard rate can be one source of error and confusion our paper addresses. For example, if the mortality rate was 12 wolves per year in a population of 100 wolves, the per capita hazard rate can be expressed as 0.12 per year. Within that estimate, one can express the risk of different causes of death as a percentage of 0.12 wolves per year.

What implications does this study have for the viability of endangered wolf populations?

With the prior definitions in mind, mortality risk does not directly inform us about the mortality rate, because the risk estimate does not reveal how many marked animals were in the original pool or the time period under discussion. However, it is axiomatic in conservation that one abate the most severe threats to endangered species with high priority, so paying attention to mortality risk is common-sense.

Also, our analysis revealed that marked animals that were monitored (known fates) experience different risks than animals that were not monitored (unknown fates). Because the vast majority of any population is unmonitored, we should be careful about assuming we understand viability when we base our conclusions on monitored animals (known fates) only, or even when we base our conclusions on marked animals (known and unknown fates) because unknown fates vastly outnumber known fates.

Furthermore, mortality rates are also likely to have been mismeasured in wolf populations. If one has under-estimated the major risk faced by marked wolves, one has likely also under-estimated the per capita hazard rate of all the other unmonitored animals simply because scientists and agencies extrapolate from the marked animals to the whole population. In the case of wolves, marked wolves actually experienced more poaching than scientists or government agency acknowledged. Also, we know from the Wisconsin mortality study[1] that poaching happens earlier in life than death from nonhuman causes or vehicle collisions on average. The same seems to be true for Northern Rocky Mountain wolves[2]. Furthermore, per capita hazard rates of unknown fates differed from those of known fates in three wolf populations where both have been estimated. Because poaching is the major risk for all of the wolf populations we studied (Figure 3), we recommend re-evaluation of all policy interventions that increase mortality or choose not to address human-induced mortality, using our more accurate methods of estimation. We predict that wolf population viability and their resilience to human-induced mortality is not as rosy as U.S. governments have predicted.

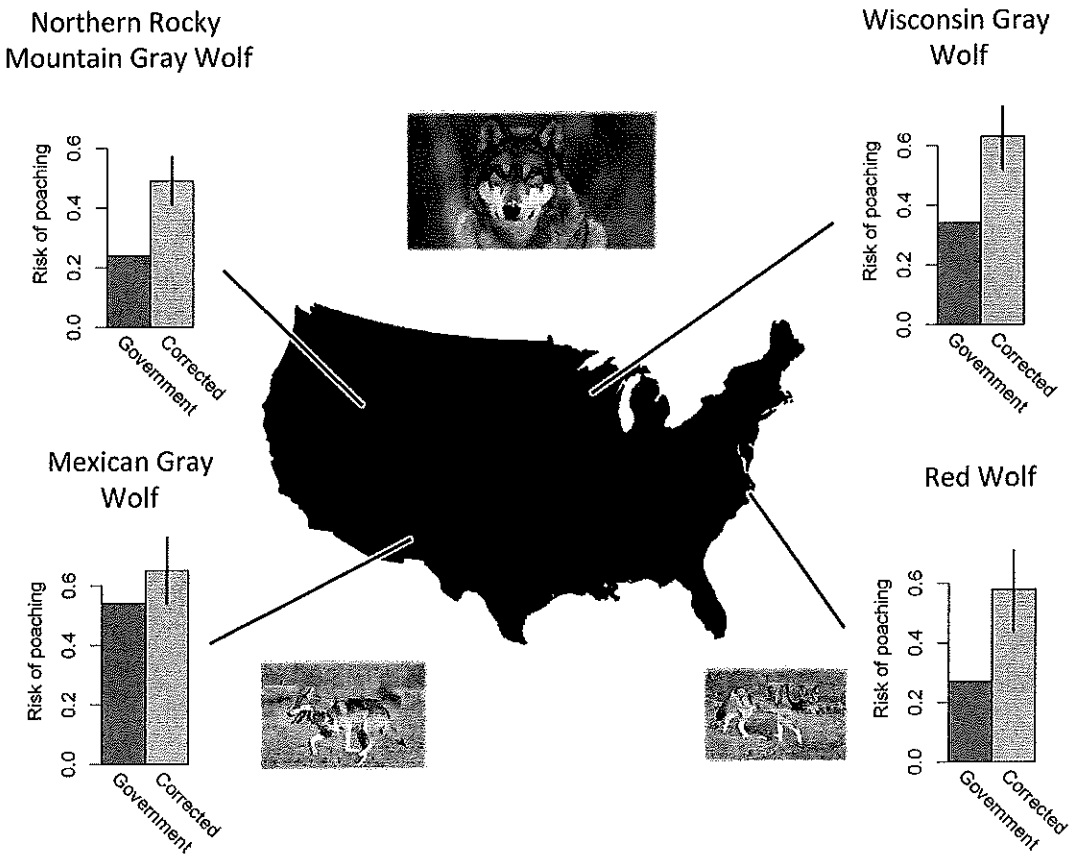


Fig. 3.—*Endangered wolves (gray: Canis lupus, Mexican gray: C. l. baileyi, and red: C. rufus) and risk of mortality from poaching as a proportion of all deaths. Approximate geographic locations are shown for 4 populations in the United States. The relative risks of mortality from poaching by government estimates (dark gray bars, no uncertainty estimates available) are paired with the same estimates from this study (light gray bars; error bars: lower bound derived from the equal apportionment approach and upper bound derived from the Scandinavian estimate of cryptic poaching C =2). See Supplementary Data S2 for poaching values separated from other human causes.*

How did this happen?

The propagation of errors and their widespread publication and dissemination represents a systemic problem in which evidence is not handled with sufficient care before policies are made. Government agencies are placed in a privileged position with regard to accessing data paid for by taxpayers and collected in the public interest. Yet agencies are not required to submit their findings to rigorous peer review by anonymous, independent experts in the field, as is required for scientific publication. The consequences of failing to subject government science to peer review are particularly obvious in the case of wolves that we have presented, but similar less stark errors are certainly missed because government evidence is not peer reviewed rigorously. We recommend the system be reformed to follow the academic sciences model. This recommendation should not be interpreted as uncritical endorsement of academic peer review, which has proven flaws also. Although academic peer review is not perfect, it is demonstrably superior to no peer review or lack of independence among peer reviewers hand-picked by government agencies. The next task after that is to strengthen academic peer review.

Chair Finley, Members of the Commission,

My name is Steve Wastell. I came from Los Angeles yesterday. I am the co-founder of Apex Protection Project based in Los Angeles. We are a non-profit wolf and wolfdog rescue, education, and advocacy organization. I love wolves. I think wolves and all wildlife should have the right to live. But I was told about this meeting and encouraged to come by a prominent member of the livestock community of Oregon after meeting him at The Working Circle Collaborative's non-lethal coexistence workshop a few months ago. Why? Because at that workshop a wolf advocate and a rancher shook hands and talked to each other simply as people. That conversation meant something to me. It proved that there's a possibility that two sides with opposing views can come together and work on finding a solution.

That being said, with the current wolf population of approximately 112 wolves in Oregon it is very premature to develop a wolf hunting plan. Trapping and snaring is considered inhumane and should not now, or in the future, be allowed. It does not empower the livestock community to allow hunting and trapping of wolf packs. It leads to smaller pack sizes, more packs, and has been proven in Montana to lead to more predation.

There are groups such as The Working Circle Collaborative and The Blackfoot Challenge who I have first-hand experience with who are actively and effectively reaching out to the ranching and farming communities and working with them, helping to dispel myths, arming them with knowledge, and helping to bring new practices to an age-old lifestyle and tradition - a tradition this country was founded on but can be enriched with new practices that support the desire of the majority of their consumers.

This polarizing argument of wolf management has been going on a long time. Until now, Oregon, compared to the rest of the county, has had a reasonable wolf management plan so why not keep that going and think outside of the box. I come from the city. I am a consumer. I love steak. I love wolves. And I know there are thousands of people just like me. Instead of killing wolves, why not consider developing programs that encourage the consumer to help fund non-lethal coexistence efforts and empower the livestock community.

Stephanie Taylor

Predator Defense
Helping people & wildlife coexist since 1990

PUBLIC COMMENTS ON REVISION TO OREGON WOLF PLAN

DATE: May 18, 2017

TO: ODFW Commission Chair Finley, ODFW Director Melcher, ODFW Commissioners,

FROM: Stephanie Taylor, Wolf Policy Advisor, Predator Defense

Predator Defense is a national nonprofit advocacy organization headquartered in Eugene, Oregon, with more than 15,000 supporters and followers throughout the United States. Our mission is to protect native predators and end America's war on wildlife.

We do not support the Wolf Plan Revision as it is currently written. The majority of residents want Oregon's wolves to truly recover, and that cannot happen with the Wolf Plan Revision being proposed. To remedy this, we offer the five (5) comprehensive recommendations below, and we thank you in advance for seriously considering them.

1. Create Stronger Protections for Wolves

Because the Oregon Wolf Plan will determine the fate of wolves for at least the next five years, the significance of the plan's revision cannot be overstated. We would like to remind the Fish Wildlife Commission and the Oregon Department of Fish & Wildlife (ODFW) that the agency represents all Oregonians and that the majority of residents have repeatedly and overwhelmingly voiced strong support for wolf recovery. True recovery will only happen with a Plan focused on conservation and increased protections for wolves during this critical phase in their population growth.

The Commission prematurely removed state endangered species protection in November 2015, circumventing both the best-available science and the public will. This delisting was done with the promise of a strong conservation focus in the Wolf Plan revision. The Commission also indicated publicly that there would be "an ask" to the legislature to increase penalties for poaching, which has not yet been realized.

In a time when we have seen an increase in poaching along with a decrease in social tolerance for wolves, this plan revision fails to address the real impacts of poaching or suggest stronger enforcement of

Oregon's wildlife laws. We want to see a greater focus on addressing wolf poaching, and on the poaching of ungulates that may lead to killing of wolves.

There have been 3 known poaching deaths to collared wolves very possibly resulting from the release of location data to livestock owners, and yet there has been zero enforcement or accountability for these poaching incidents. Therefore, we oppose sharing wolf collar data with the general public.

We want to see a wolf management plan based on conservation science, full recovery, and analyzing wolves' important ecological role in the larger landscape, and therefore we oppose management zones and wolf population caps. Wildlife is held by the state as a public trust for all Oregonians, and we ask that wildlife be managed as such, for the sake of biodiversity. While our understanding of the role of wolves and other apex predators is evolving, there can be little doubt that they – like all native wildlife – play an important and irreplaceable role on the landscape. For wolves to fulfill their ecological function as top predators means having a far more robust population than the minimum needed to preclude extinction. This is especially critical if lethal removal of entire packs is used as a management tool. Wolves are self-regulating. Killing wolves to maintain arbitrary population caps will increase conflict, and limiting wolf distribution to management zones can jeopardize recovery efforts. We object to a plan with such limited population design and language that implies wolf population caps are a foregone conclusion.

During the rest of the review process, we ask the agency make management decisions based on peer-reviewed sound science. This means managing wolves based on historic range and carrying capacity, and not population caps or designated wolf zones.

With unsettled litigation of the delisting decision, a wolf plan revision process not yet complete, a continued distrust of the agency, and the agency-sponsored demise of the Imnaha pack in Oregon, now is not the time to weaken protections in the Wolf Plan. Stronger protections for wolves could help mitigate the public controversy the agency has created under current management.

2. Clarify Consistent Ambiguity in the Plan's Language

Lack of clarity due to ambiguous language in the Wolf Plan and lack of transparency within the agency has and will continue to create conflict and confusion. To avoid future conflict, we recommend clarifying specific terms to include transparent and enforceable measures:

- One of the Guiding Principles of the Review is to "Maintain the principle of increasing flexibility in management options (wolf-livestock conflict) as the population increases." Clarification is needed on all sides as to what "flexibility" means, what management measures will be triggered, and what number the population must reached to trigger those management measures.

- The plan's definition of "chronic depredation" will not adequately protect wolves and ignores what has worked to reduce wolf-livestock conflict. Had the proposed definition existed in 2016, it would have allowed 25 of Oregon's 112 known wolves to be killed.

- For the first time, "probable" wolf-caused losses would count toward issuance of a wolf kill order, despite no scientific evidence it will result in fewer conflicts or target the wolf that may have been responsible.

- Clarification of non-lethal measures. What tools are currently required? How many layers of non-lethal measures, and for how long must they be in place?

3. Clarify Required Non-lethal Measures

Conservations are calling for transparency, clarity, and enforceable standards that make killing wolves in response to livestock conflicts a last resort option. Since wolves returned to Oregon eight years ago, wildlife managers have killed wolves in three separate livestock depredation incidents. The state wolf plan currently requires landowners to "attempt" nonlethal wolf deterrence in order to receive full compensation of losses and before resorting to lethal measures, yet the plan does not list what those required nonlethal measures must be. The draft plan would require documentation of non-lethal methods "reasonable for the situation" with no further explanation. This imprecise language is confusing to the public and landowners, and unenforceable for the agency.

Conflict deterrence plans coupled with clear, defensible definitions and timely qualification reports give certainty to all stakeholders, reduce conflict and should be continued.

We're asking for not only the clarification of non-lethal measures, but for the agency to prioritize the implementation and use of the non-lethal measures above lethal control. And until the revision process is completed, the Commission should prohibit any further lethal control.

4. No Wolf Hunt; No Trapping

While Oregon's previous wolf management plan did not permit hunting or trapping seasons, the current draft does allow for targeted hunting and trapping by the public under certain circumstances. We strongly disagree with this management decision and do not believe there is scientific evidence that shows killing wolves decreases conflicts. Therefore we recommend that all revision of the plan exclude any kind of sport hunting and trapping. The livestock industry and some in the hunting community are calling for making it easier to kill wolves and trophy hunting as soon as next year. Contrary to what the agricultural interests expected, depredation on livestock decreased during the time Oregon's wolf population increased. And yet, our wolf population has only increased by two individuals.

Wolf hunting and trapping is broadly opposed in Oregon, and science indicates that its allowance may decrease social tolerance for wolves, leading to more poaching. Some biologists claim that wolves are enormously fertile and resilient in recovering their population numbers, therefore the "remedial control" is acceptable and their population will not decline (Wiles GJ, 2011). This superficial approach neglects that wolves are individuals with unique characteristics, behaviors, and strengths who are part of a complex social structure. Lethal measures will have extensive and long-term negative effects being social dislocation, trauma, loss of pack mentality, and pack feeding behaviors. The wolf is highly resilient demographically, but its social structure increases the area requirements for viable populations. (C. Carlos, et al. 2001). An example of this is the research study out of WSU (Wielgus, et al. 2014) which assessed the effects of wolf pack complex social functions and the effects of wolf mortality on reducing livestock depredations in Idaho, Montana and Wyoming from 1987–2012 using a 25 year time series. The results conclude that killing wolves and other native predators such as cougars and coyotes to mitigate livestock depredation is actually having the opposite effect. While shooting carnivores may seem like the

most logical and direct response, the study shows that by killing wolves, social cohesion of the packs become disrupted resulting in an increase in livestock depredations. This study found that the increasing wolf killing results in increasing the odds of livestock depredations 4% for sheep and 5-6% for cattle. The results of this study found that killing wolves only helps protect livestock after 25% of a wolf population has been killed. (Wielgus, et al. 2014). Less focus on conflict prevention and less restriction on killing wolves (which is more likely as non-lethal conflict prevention is de-emphasized) means more depredations and more killing of wolves, which leads to discrediting of non-lethal measures (Wielgus). Even when under endangered species protections, most documented Oregon wolf deaths have been human-caused. The predominant human-caused death has been ODFW lethal control due to depredation, the second being illegal take.

The outcomes of post-listing Phase IV management of the Wolf Plan are currently unknown, but could directly affect population numbers. Hunting and trapping for sport is not precluded and politically powerful interests have already asked for recreational hunting and trapping seasons such as those that have taken place in states such as Idaho, Wyoming, Wisconsin, and every other state with a meaningful wolf population where wolves have been delisted.

The Plan allows lethal measures on wolves to ensure game herds stay abundant. These proposed revisions would allow wolves to be killed whenever they are a "significant factor" in ungulate decline, a reduced threshold from the existing plan, which requires that wolves be "the cause." Lethal control would be allowed even at state-sponsored elk feeding sites, which are wolf attractants. Wolves should not be blamed for impacts to big game harvest – or decreasing tag sales – in Oregon.

Currently ranchers get full compensation for confirmed wolf depredations, partial compensation for "probable wolf depredations," and partial compensation for "missing livestock above normal," both on public and private lands, and from taxpayer dollars. Livestock Subsidies in Oregon totaled $62.4 million from 1995-2014. Less than a quarter of one percent (0.2%) of the American cattle inventory was lost to wolves in 2010, according to a Department of Agriculture report. That means that 99.8% were losses from health issues, weather, theft, and other non-wolf causes. Yet none of these losses receive compensation. Ranchers would benefit to lose their livestock to wolves where they have better chances of financial compensation. We mention this, because another Guiding Principle for the Wolf Plan Review is to "Address ODFW resource limitations when evaluating future commitments." The cost of contracting Wildlife Services plus the cost of deploying helicopters to lethally remove wolves (after ranchers have already been compensated) should be a strong topic for ODFW resource discussions. We believe it is an irresponsible waste of limited agency funding, and ranchers should foot the bill, not the taxpayers.

We oppose the proposed deputizing of members of the public by ODFW to hunt or trap wolves. Delegating wolf-killing authority to the public incentivizes conflict, is ripe for abuse and is a "foot in the door" for general wolf hunting and trapping seasons in Oregon. With compensation programs in place and studies showing that lethal removal of predators increases depredation and decreases social tolerance, we strongly advise against future lethal management. There is absolutely no biological, social, ecological, or economic reason for a wolf hunt with 112 wolves across the state and a population showing significantly slowed growth.

5. Remove Wildlife Services from Investigating Depredation Claims

Wildlife Services is already a controversial agency with the general public. This month, Predator Defense filed a lawsuit against Wildlife Services in neighboring state of Idaho when the agency wrote a statewide authorization to kill native predators without taking a hard look at the impacts of its unscientific slaughter. The agency has also never revealed to the public the potential consequences of its actions, as the National Environmental Policy Act requires. This is how the agency routinely conducts itself.

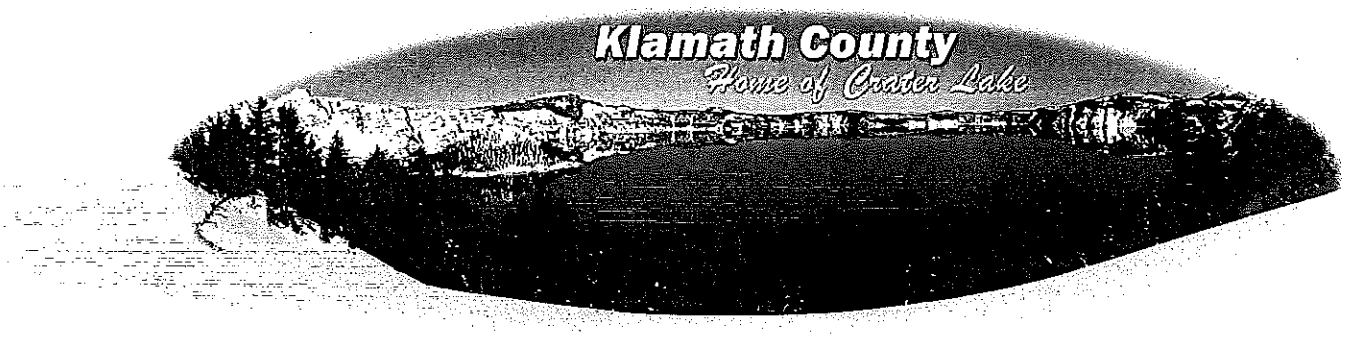
In Oregon, Wildlife Services was previously removed from its investigative role by the Department due to its failure to conduct objective, evidence-based investigations. Wildlife Services routinely confirmed depredations where ODFW did not find sufficient evidence.

# # #

Carol Pearsall

My constituency doesn't exist. I'm no one's elected representative or official. However, I hope you consider me an Oregonian who has made the drive from Lincoln City to speak for the 72% of Oregonians who do not want wolves killed in this state for any reason. We want the cattle off of public lands altogether. If that requires that the USFS rewrite language dating back to Teddy Roosevelt's presidency, then so be it. "Mixed use" of public lands kills wolves. Predators and prey cannot mix as long as human beings profit on raising, selling, and slaughtering the animals' natural prey.

Also, and at the very least, we want grazing rights rescinded for anyone who turns cattle out on known wolf den or rendezvous sites. That is bad animal husbandry at best and a declaration of war against predators and the wild ecosystems that still remain intact in Oregon, at worst. I am profoundly sorry personally that these changes all have to come on land that ranchers think of as theirs, because that means they have to do all the changing and change is hard. But 72% of Oregonians want it and that is public land. That's the way it is. Ranchers are proud, hardworking people, who pride themselves on facing facts and not putting their troubles on others, so why has it not happened already?



April 21, 2017

Committee Members
Oregon Fish &Wildlife Commission
4034 Fairview Industrial Dr. SE
Salem, OR 97602

RE: Wolf Conservation and Management Plan Review

Dear Committee Members,

Agriculture is one of the largest economic drivers in Klamath county. The Board of County Commissioners is extremely concerned with any threat to our rancher's and farmer's livelihood. We view wolves as a significant potential predator to our ranching operations in Klamath County. We request that any action taken related to this issue take in to account the potential loss of livelihood for our agricultural community.

We have a Natural Resources Advisory Committee and Wolf Advisory Committee and would be happy to connect you with representatives from either committee, if you have questions pertaining to the potential impact of this plan on Klamath County.

Sincerely,

Kelley Minty Morris,
Chair, Klamath County Board of Commissioners

KMM/hh

305 Main Street, Klamath Falls, Oregon 97601
Phone: (541) 883-5100 | Fax: (541) 883-5163 | Email: bocc@klamathcounty.org

Steve Wastell

Chair Finley, Members of the Commission,

My name is Steve Wastell. I came from Los Angeles yesterday. I am the co-founder of Apex Protection Project based in Los Angeles. We are a non-profit wolf and wolfdog rescue, education, and advocacy organization. I love wolves. I think wolves and all wildlife should have the right to live. But I was told about this meeting and encouraged to come by a prominent member of the livestock community of Oregon after meeting him at The Working Circle Collaborative's non-lethal coexistence workshop a few months ago. Why? Because at that workshop a wolf advocate and a rancher shook hands and talked to each other simply as people. That conversation meant something to me. It proved that there's a possibility that two sides with opposing views can come together and work on finding a solution.

That being said, with the current wolf population of approximately 112 wolves in Oregon it is very premature to develop a wolf hunting plan. Trapping and snaring is considered inhumane and should not now, or in the future, be allowed. It does not empower the livestock community to allow hunting and trapping of wolf packs. It leads to smaller pack sizes, more packs, and has been proven in Montana to lead to more predation.

There are groups such as The Working Circle Collaborative and The Blackfoot Challenge who I have first-hand experience with who are actively and effectively reaching out to the ranching and farming communities and working with them, helping to dispel myths, arming them with knowledge, and helping to bring new practices to an age-old lifestyle and tradition - a tradition this country was founded on but can be enriched with new practices that support the desire of the majority of their consumers.

This polarizing argument of wolf management has been going on a long time. Until now, Oregon, compared to the rest of the county, has had a reasonable wolf management plan so why not keep that going and think outside of the box. I come from the city. I am a consumer. I love steak. I love wolves. And I know there are thousands of people just like me. Instead of killing wolves, why not consider developing programs that encourage the consumer to help fund non-lethal coexistence efforts and empower the livestock community.

Chair Finley & Commissioners,

I am for the conservation of wolves in Oregon, and will continue to closely follow the wellbeing of wolves in Oregon and ODFW's management toward conservation of this important native, keystone species.

I oppose wolf hunting, trapping, and the killing of wolves in Oregon.

A key component of ODFW's mission is to, "provide proactive and solution-based fish and wildlife management based on sound science," for the goal of, "protecting and enhancing Oregon's fish and wildlife and their habitats."

I believe the current Oregon Wolf Plan & Draft is grossly flawed, and ineffective. The Oregon Wolf Plan Draft promotes greater conflict:

The plan requires no clearly defined, substantial, enduring, enforceable expectations from producers.

The plan incentivizes/rewards producer irresponsibility and livestock depredation with compensation, and/or kill-management of wolves.

The plan misplaces responsibility AND consequences onto wolves; influencing wildlife toward conflict scenarios or depredation leads to fulfillment of kill management of victims/wildlife.

The plan misrepresents/scapegoats native wildlife as, "problem wolves" with erroneous, "chronic depredator" terms to support false justification for, "tolerance killing." The Oregon Wolf Plan Draft definition of, "problem wolves" is wolves that depredate 3 livestock per year – this depredation threshold is far too low for a plan that only requests, "good faith efforts" from producers.

The plan's definition for chronic depredation is not chronic depredation; it is acute depredation. Acute depredation is often the result of poor livestock management (depredation influenced by mismanaged attractants, failure to implement most effective non-lethal deterrents, delayed reporting, etc.).

The plan, and depredation reports do not distinguish (M) depredation coinciding with/related to mismanagement, or delayed reporting, from (C) depredation not coinciding with/unrelated to mismanagement, or delayed reporting. (M) Depredation influenced by mismanaged attractants, failure to implement most effective non-lethal deterrents, or delayed reporting should not result in compensation or kill-management considerations. (M) Depredation should result in the resolution of factors promoting depredation, and penalties/loss of region depredation filing 2< months following resolution of mismanagement.
Non-compliant producers increase the risk of conflict/depredation within their

/,

region. A plan earnestly aimed at reducing conflict will penalize the controllable factors that perpetuate conflict within a region. We don't want a plan that has producer communities more invested in earning creative math, ".5 probable qualifying depredations" than they are focused on responsible, proactive livestock/business management. **ODFW should not perpetuate conflict promoting behaviors with the reward of kill management within a region of mismanaged attractants.**

The plan entertains the fallacy that kill management builds, "trust," and, "tolerance" among ODFW's special interest stakeholders. The public knows that latter phase terms & resulting kill management do not build trust, or tolerance; it lowers standards that previously worked, encourages depredation, rewards conflict, and gives special interest what they want.
Kill management is how some F&W agencies create bigger, more widespread problems, and build revenue from subsequent, "conflict management." Wolves are a ready-made scapegoat; we've seen the conservation, to management, to kill/trophy tag profit formula failures and the intense social division it creates. ODFW should work toward the preservation/protection of all species in an ecosystem, not just the ones special interests pay them to manipulate. **ODFW shouldn't be about the business of prioritizing special interest, "trust and tolerance" above its broader public trust. ODFW shouldn't be about the business of prioritizing special interest, "trust and tolerance" above its commission to provide proactive, solution-based, protection/preservation of wildlife, and habitat utilizing sound science.**

More Oregon Wolf Plan Draft depredation problems:

I oppose the subcontracting of depredation investigations, or any part or implementation of the Oregon Wolf Plan to potentially biased parties: Wildlife Services, local law enforcement, deputized public, elected officials, local veterinarians, etc. ODFW should retain sole, centralized, clear authority in ALL aspects of the Oregon Wolf Plan. **ODFW should not subcontract out the kill management of wolves;** ODFW should have no issue standing for & bearing the weight of all aspects of the Oregon Wolf Plan. No matter the terms, ODFW will be held accountable; there won't be excuses, or hiding behind other agencies/entities.

I appreciate ODFW's current, swift response to suspected depredation. I value ODFW's objective, fact led investigations of suspected depredation. **ODFW should concede to facts, and sound science in all aspects of its work, and above all else reject any plan provisions that would unnecessarily complicate, promote confusion, increase drama, or embrace, "no such thing" alternative facts.** When we rely on objective facts, and facts alone, there either is proof/enough evidence to

confirm depredation, or there is not proof/enough evidence to confirm depredation; there is no such thing as two, ".5 probable depredations" creating an actual one. ODFW shouldn't be acting on the muddied stage of subjective possibilities, perceived attempts, or the childish waring math of earning wolf kills. Please, keep it simple, and at least hold fast to the parts of the plan that have worked. **Depredation Investigations must be based on accurate and defensible facts.**

Depredation events should be correlated with producer awareness of depredation and response to depredation. Under the current plan, several depredations may be filed for what is essentially one depredation event. By the time a producer realizes, or reports there have been depredation/s, the, "depredation number" may already be 3 or more without producer intervention, presence, carcass/attractant removal, multiple most effective non-lethal deterrent measures, etc. The current depredation qualification rewards producer absence/lack of vigilance/irresponsibility, and incentivizes further depredation. **The definition of separate qualifying depredation events should be marked when the producer has reported the suspected depredation to ODFW, placed fladry around the carcass or secured dead or injured livestock, AND taken documented (time/date stamped video) defensible, clear, consistent, most effective non-lethal deterrent measures to actively deter further depredation.** Two of the measures should be 1. Most effective site-specific attractant removal/livestock management, and 2. Consistent producer presence with livestock.

The Phase 1 depredation threshold, 4 confirmed depredations within 6 months, is too low, and not fitting the chronic definition. I am against a lower threshold number, or longer time frame than what was set in Phase 1. The draft's proposal that 3 depredations within one year meet the definition of chronic is blatantly false. Chronic depredation is showing prolonged, sustained, consistent dependence/reliance on as primary food source, more so than natural food source vs. Acute depredation having a sudden onset, sharp rise in, lasting a shorter time. Most of what is now labeled as chronic depredation is acute depredation. **ODFW should not reinforce/perpetuate the manageable causes of acute depredation with kill management.**

Unless ODFW/taxpayers are willing and prepared to cover all personal loss, public loss, and damage control from any resource under ODFW's management umbrella, **depredations on public lands should not qualify for kill-management consideration.**

The Oregon wolf plan should acknowledge and address the illogical grazing (incongruent with the goal of minimizing wolf – livestock conflict) of livestock within 8 miles of suspected, or known wolf den, rendezvous sites, or if unknown, center of most recent pack territory. **Recent data from the Rocky Mountain Recovery**

Area suggest that individual wolves do not automatically prey on livestock, but members of wolf packs encountering livestock on a regular basis are likely to depredate sporadically (Bangs and Shivik 2001, https://www.californiawolfcenter.org/downloads/wolf-livestock-conflict-NW-US-Bangs-and-Shivik.pdf).

Unless ODFW has implemented provisions (cattle-collar interface) that prevent detection of wolves until they are in range of livestock, **I am against utilizing collars that people, other than ODFW, can track throughout wolf territory.**

Please consider that the precedence taken by ODFW will set the general social acceptability of killing and poaching. When departments of fish and wildlife kill wolves, the public perception, "for killing wolves" is reinforced. If ODFW engages in the kill management of a species it proposes to conserve, ODFW should substantially increase penalties for illegal take/trapping/poaching of wolves, AND support methods of successfully identifying and prosecuting illegal take/trapping/poaching of wolves.

We will not realize effective, enduring management solutions until we are forthright about the origins of livestock-wolf conflict. I ask ODFW to lead, earnestly identifying and sufficiently penalizing the behaviors that negatively influence wildlife and promote livestock-wolf conflict. There are not many government subsidy programs, especially as generous as the ones granted livestock producers, that do not require clear, pre-qualifying stipulations of the recipient. **Clearly defined, substantial, enduring, enforceable requirements of producers are the continuing foundation throughout all phases of any effective, "minimizing livestock-wolf conflict" management plan. Enforceable requirements, that deter/minimize conflict/depredation, protect the social and economic interest of all Oregonians, while supporting conservation of gray wolves as required by Oregon law.**

As ODFW moves forward in time, please remember – the public awareness and concern for wolves, and the protection of native wildlife, and healthy habitat is increasing. The public awareness, concern, and committed involvement will only continue to increase. Yours are not the only eyes out on public lands; the public has eyes out on public lands too. The truth of public lands grazing, and wildlife management, will continue to be documented, recorded, and revealed. As with the unfortunate cases of livestock mismanagement in Washington's Kettle River range, the parties responsible for negative impacts to healthy habitat and native wildlife will be shown in a blaring spotlight – ODFW should be on the side of protecting healthy habitat, and all native wildlife.

ODFW, please strengthen protections for, and conservation of Oregon's wolves. Retain and fortify clearly defined, enduring, enforceable common sense measures. At minimum, carry forward the (Phase 1/prior to 2015) parts of the plan that previously worked to reduce conflict.

Thank you for your consideration,

Kim Pearson
Oregon

Lindsay Raber

May 15, 2017

Chair Finley, members of the Commission, for the record, my name is Lindsay Raber. I live in Lotus, California, an unincorporated community within the Sierra Nevada foothills of El Dorado County. I am here today speaking to my individual views regarding Oregon's draft, revised Wolf Conservation and Management Plan. I will also share that I am the Coordinator of the Pacific Wolf Coalition, an alliance of wildlife and land conservation organizations and individuals across Oregon, Washington and California. Collectively, we are dedicated to facilitating wolf recovery efforts in the Pacific West.

I would like to begin by thanking the Commission for holding today's meeting and a special thank you to the Commission for holding this meeting in Portland - the first time the Commission has done so.

I live in a state where wolves are returning. Correct me if I'm wrong, but all of us in this room also live in a state where wolves are returning. We have this in common, even if our views about wolves are different. There is a guiding principle of the Pacific Wolf Coalition that I value greatly and I think it lends value to today's hearing: As wolves return to the Pacific states of Oregon, Washington and California, they do so on a vastly different social, political and ecological landscape than elsewhere in the country. This creates opportunities and challenges unique to the region. Let me iterate – this creates opportunities. Oregon's Wolf Plan is an opportunity to address some of the challenges faced when determining this state's management of wolves.

Oregon's Wolf Plan is a model for other states, but additional revisions are necessary. I applaud the efforts of you all, and many others, to develop a Plan before wolves made their return to the state. However, there was an agreement that the Wolf Plan would be reviewed and updated every 5 years, and now this current review and revision process is delayed by more than a year.

I am concerned with several elements of the draft revised Plan. I am particularly concerned with the Plan's unclear language about the requirements for non-lethal conflict deterrent measures. The guidance for these requirements is limited. The requirements for these measures lack clarity and needs further explanation. I would also like to see a clear explanation of the impacts of wolf poaching in Oregon, and the poaching of ungulates that may lead to killing of wolves, addressed in the Plan. Furthermore, all definitions, terms, and requirements in the Plan should be transparent, defensible and enforceable.

I oppose the involvement of local elected officials to make consequential depredation decisions. Wildlife is part of the public trust and should be honored as such. Additionally, killing wolves to maintain arbitrary population caps will increase conflict. The Plan works best and reduces conflict when all stakeholders have clear expectations of themselves, each other, and the agency.

This is a critical time for wolf recovery in Oregon and I urge you to consider the points shared today, by myself and others in attendance today. Ultimately, provisions that work to reduce conflict *and* conserve wolves should be carried forward in the Plan.

Thank you for your time.

Chair Finley, Commissioners:

Thank you for the opportunity to testify.

I'm Wally Sykes, resident in Wallowa County for over 21 years and a wolf advocate since 2008. I fully support today's testimony by Cascadia Wildlands, Oregon Wild, The Center for Biological Diversity, and Defenders of Wildlife.

I regularly hike and camp in wolf country with my dog, and have seen and heard wolves. I've had 8 wolves at once pass within 100', been barked at, howled at, and no doubt observed often. Never was I threatened, or my dog attacked, or did I feel alarm. Wolves have occasionally been near my house and my neighbors', without harming dogs, cats, kids, horses, or pigs.

Wolves have historically been, and forever ought to be, part of the natural landscape, like trees. They have a right to be here, and are agents for healing and maintaining disrupted ecosystems, a quality largely ignored in the draft plan.

They deserve the same respect we are re-learning to accord to all wild things.

That is why I reject trophy hunting of any animal, and I object to deputizing civilians to hunt wolves for any reason. If the State feels it must kill wolves, then it should kill dispassionately, respectfully and professionally. Volunteer "Master Hunters" or, worse yet, "Master Trappers," kill for pleasure, trophies and status, demeaning their victims, and set a precedent for wolf hunts.

Killing wolves to bolster ungulate population objectives, themselves at times arbitrary, is to prioritize hunting over conservation, violating the public trust. Ungulates decline due to many conditions. Disease, climate, over-hunting, poaching, and other factors are always significant. Wolves should not be scapegoats when the blame is widely shared among many factors. Only when wolves are proven the *primary* cause of sustained ungulate declines should measures be *considered* to mitigate wolf/ungulate interaction, and even then ecological integrity should be the most important determinator, not hunting opportunities.

Killing wolves for eating their natural prey repels most Oregonians, which the Commission certainly knows from hundreds of public comments, a 2016 poll and most recently a letter from 18 Oregon legislators.

Killing wolves around winter elk feeding sites is outrageous. Feeding sites are an artifact of wildlife management, an unnatural attractant, and to kill wolves for naturally following their primary prey to areas where they are artificially concentrated amounts to wolf baiting. Concentrating elk itself facilitates disease, such as Chronic Wasting Disease, and studies have suggested wolf predation in fact reduces contagion.

We live in a time of massive wildlife and habitat destruction. Let's hold the line here in Oregon.

Oral public testimony regarding
the draft 2017 Oregon Wolf Conservation and Management Plan
May 19, 2017, Portland Oregon

Chairman Finley and fellow commissioners, I thank you for this opportunity to provide public testimony. My name is Robert L. Beschta and I have a background in forest ecosystems, riparian ecology, and hydrology. I have been with Oregon State University since 1974 where I am currently an emeritus professor.

A quarter of century ago, in 1992, Yellowstone National Park was considering the reintroduction of wolves and compiled a report to Congress entitled "Wolves for Yellowstone?" A large portion of that report focused on potential wolf predation on elk and deer as well as depredation of livestock. There was no discussion of food webs or trophic cascades. There was no discussion that restoring wolves might help to recover aspen stands and riparian areas that had become increasingly impacted by elk during the seven decades when wolves were absent.

Fast forward to today, some 25 years later. Based on my count, the Oregon draft wolf plan uses words such as "loss" (41), "damage" (22), and "conflict" (99) a collective 162 times; the term "livestock" is mentioned over 250 times! The term "benefit" is used only 4 times, and never in the context of wolves. I suspect a reader of the draft wolf plan will find little reason to support wolf conservation.

Furthermore, terms such as "apex predator," "keystone species," or "trophic cascades," which clearly describe wolves, are not included in the plan. Thus, it would seem that science has learned nothing new about the ecological role of wolves during the last 25 years. Such a conclusion could not be further from the truth.

When apex predators such as wolves exert top-down effects through ungulate prey to the lower-most trophic level, the vegetation, this is known as a "trophic cascade." Over the last two decades, the scientific community has increasingly studied the importance of trophic cascades on the composition, structure, and function of plant communities. We have gone from essentially "zero" publications on this topic in the period before the Yellowstone wolf reintroduction (i.e., 1986-95) to nearly 600 peer-reviewed studies over the last 10 years (i.e., 2006-2015). A number of these studies addressed two fundamental questions:

(1) *Are there any major ecosystem consequences of extirpating wolves in Yellowstone and elsewhere?* The answer is a definite "yes" and today we well know, that in the absence of wolves, impacts to both upland and riparian plant communities have been severe due to unimpeded herbivory by native ungulates. I would also like to indicate that over the course of my professional career I have observed and measured ungulate-impacted aspen stands and riparian areas on many areas of public land in Oregon, impacts very similar to those found in Yellowstone.

(2) *Are these impacted systems recoverable if we put the predator back?* Again, it looks like the answer to this is also "yes" and where wolves have returned various studies are documenting the early phases of ecosystem recovery.

I have attached a figure published in Science in 2014 that briefly summarizes the multitude of direct and indirect ecosystem effects currently known about wolves and which illustrates their capability to beneficially affect the habitat needs for a wide range of upland, riparian, and aquatic species. It's an important figure.

Based on this testimony and my previously submitted written comments (submitted electronically to Oregon Department of Fish and Wildlife on May 17, 2017), I reach the following three conclusions:

(1) There is little information in the Oregon wolf plan that might help Oregonians understand the ecological importance of conserving wolves.

(2) Over the last two decades, the information base and studies supporting the science of trophic cascades has increased greatly, particularly with regard to wolves. These predators have been found to influence the behavior and density of prey populations, and thus have a critical role in sustaining biodiversity as well as helping to restore ungulate-degraded plant communities. The draft Oregon wolf plan needs a major section on trophic cascades.

(3) The extent that ungulate-degraded aspen stands and riparian plant communities occur on Oregon's public lands (Federal and State), lands which comprise over 56% of the state's area, is not identified in the plan. The plan needs to provide information on the status of these plant communities to help Oregonians understand that on many public lands there is a pressing need to conserve and maintain an ecologically effective population of gray wolves.

Overall, there is a clear scientific rationale for conserving, to the extent possible, wolves in Oregon. Doing so will help to sustain and restore the composition, structure, and function of native plant communities that are of such fundamental importance to a wide range of wildlife species.

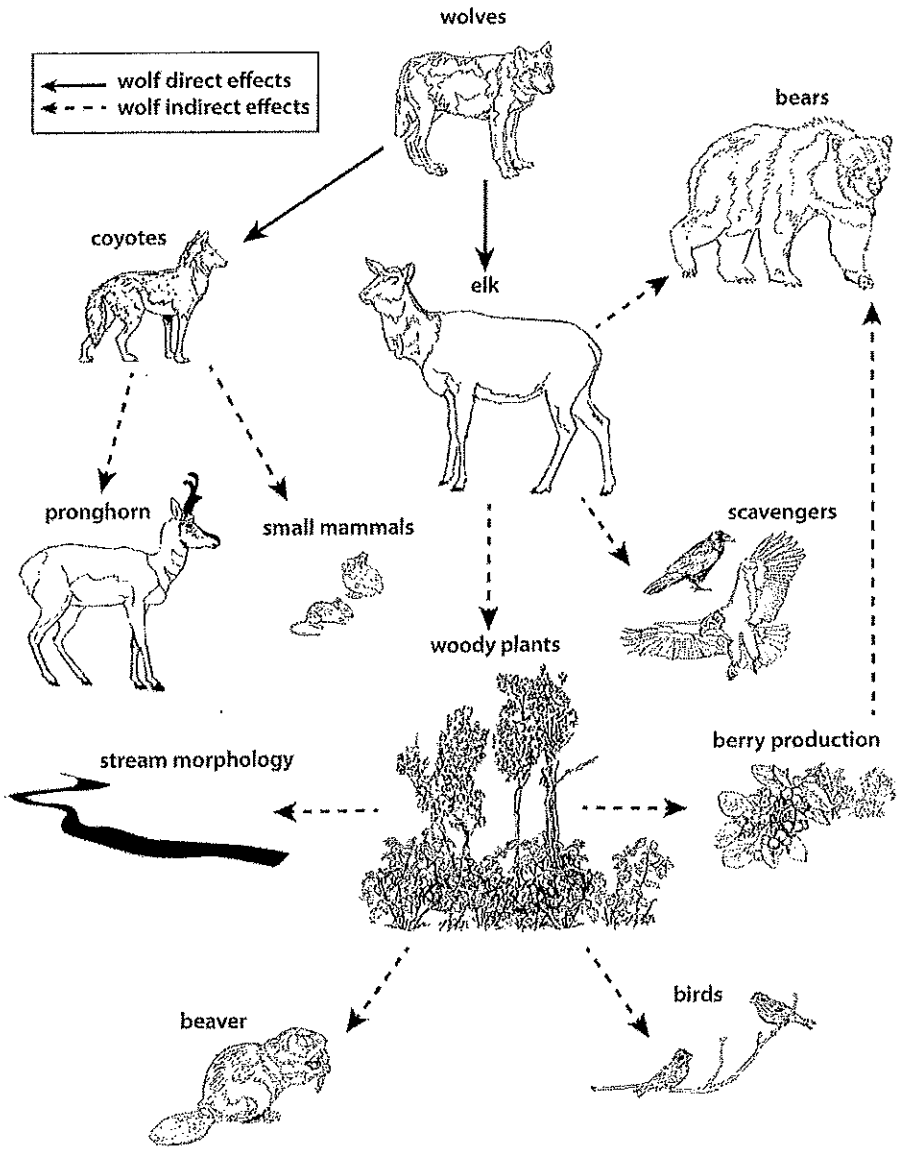


Figure 1. Conceptual diagram indicating direct (solid lines) and indirect (dashed lines) effects of gray wolf reintroduction into the Greater Yellowstone ecosystem, all supported by peer-reviewed research and publications. The direct effects of wolves upon elk and coyotes, as well as indirect effects pronghorn, small mammals, woody plants, stream morphology, beaver, birds, berry production, scavengers, and bears have been studied. This is a simplified diagram and not all species and trophic interactions are shown (e.g., elk predation by bears also exerts downward pressure on elk populations). Source: Ripple W.J., J.A. Estes, R.L. Beschta, C.C. Wilmers, E.G. Ritchie, M. Hebblewhite, J. Berger, B. Elmhagen, M. Letnic, M.P. Nelson, O.J. Schmitz, D.W. Smith, A.D. Wallach, and A.J. Wirsing. 2014. Status and ecological effects of the world's largest carnivores. Science 343: 12411484

Oregon's Wolves: A Wider Perspective

Testimony from Ann Littlewood, Portland, OR. Annlittlewood3@gmail.com

Commissioners,

I'd like to present a wider perspective for the issues we face here in Oregon with wolves. Human food production is routinely in conflict with wildlife everywhere in the world. In Kenya, elephants raid crops. In South Africa, it's baboons. In Nepal, snow leopards take domestic sheep. In Belize, it's jaguars that kill cattle. Everywhere birds and rodents eat crops. Everywhere farmers and livestock operators compete with wild grazers and predators.

Those of us who believe that the American West should retain all of its wonderful wildlife would be foolish to deny these conflicts.

The real question before us is not whether wolves are a threat to Oregon livestock operations. Wolves eat livestock, not in great numbers, but enough to trouble the ranchers. The question is how far we are willing to bend to keep our wildlife. When I say "we", I mean all of us, not just the ranchers.

The issue is how to translate the passion so many of us feel for wolves into public policy that ranchers can live with without serious economic impact and, if possible, without hard feelings on either side.

Globally, food producers have developed many, many tools to protect their crops and animals, for example, hanging bee hives to deter elephants, flashing lights to frighten away snow leopards, better corrals to defeat lions. Conservation organizations and governments initiate or support these efforts. The effectiveness of the diverse techniques varies, of course, but in many areas, the attempts to find solutions and compromises are serious, creative, and persistent.

People living with predators have also found ways to profit from them. We are all familiar with African safaris to see lions and leopards, but note that a friend of mine recently paid $4000 for a wolf tour in Yellowstone. Perhaps Oregon businesses and residents can take advantage of the widespread interest in wolves. We buy "dolphin safe" tuna. Why not "wolf-safe" beef, at a price that reflects the new management challenges that ranchers face?

I have observed that some of the poorest people in the world try very hard to live with wildlife that is far more destructive and dangerous than our own. Surely in Oregon we can do at least as well.

And I think that, in large part, we have. Oregon has not unleashed the wholesale slaughter of wolves that we've seen in other states. Ranchers have tried innovative methods to manage their animals under changing conditions.

I urge you to continue to seek solutions that tolerate some low level of predation without drastic retaliation. I urge creative, non-lethal solutions to prevent predation and to compensate ranchers fairly. I urge people to respect legitimate concerns on both sides. We can do this here in Oregon and do it well.