q**Questions from attendees 10/18/2023 and subsequent emails to the panelists**

Here is a list of the questions from the Webinar (from both Q&A and chat), edited slightly to correct typos, and removing non-substantive questions and comments:

General Questions for Everyone

1. The intrinsic value of individual animals (the value of their lives for themselves), their sentience, sapience and sociality is scientifically established. In your opinion, why is that science dismissed and should it be incorporated? Does that not speak to a bias in what type of science is considered important for 'managing' other beings? Is that a scientific and ethical failure of 'management' and conservation?

   · Answered live by first panel.

2. We need to include agencies that traditionally work with ranchers/farmers to pick up some responsibility for outreach and training in nonlethal methods. How do we do this?

Dr. Louchouarn: The answer to this question is likely more complicated in reality than it will sound here, but at the moment there is a great deal of interest in regenerative agriculture and ecosystem focused agriculture through USDA NRCS. Conservation Innovation Grants can and have been leveraged to fund projects on non-lethals which work directly with ranchers. There are also groups like the Western Landowners Alliance that are very interested in these kinds of initiatives and work directly with ranchers and farmers. My point is that in my experience I have not seen enough crossing of the boundary between agriculture and conservation, but I believe there is enough overlap in interests that in my opinion one good place to start would be to encourage both sides to collaborate, or begin going after NRCS funding and similar agriculture focused grants and programs. These initiatives are directly tied into USDA funds, and they have the ear of the farmers/ranchers.

Treves: Adoption of new techniques is always a hurdle in all human groups. Communication sciences tell us that trusted messengers are a highly effective vehicle rather than outsiders brining novel messages. Also learning what one's neighbors are doing sometimes affects one's own behavior.

3. How can some people's disbelief and distrust in scientific data be overcome so that data-based decisions can be made and supported?

   Dr. Bruskotter: The answer to this question is extremely complicated and requries a basic understanding of some fundamental psychological biases. This (link follows) should be useful for better grasping one of the most important sources of bias: LINK

4. Time is an essential consideration when we think about how to manage wildlife populations. How do we take into account future trends and future goals when we focus on a carrying capacity based on current social needs?

- Answered live by first panel.

5. If killing predators does not reduce conflict, decrease predations or add abundance to ungulate populations, why does the 'war on predators' continue unabated around the West? What responsibility do researchers and data collectors have to present best available science to decision makers regarding this matter?

- Answered live by first panel.

Treves: Ingrained belief systems in hunters, trappers, and hounders have a disproportionate say in agency policy on wildlife and generally that policy places high value on ungulates and little or no value on carnivores. Until the system changes to become more democratic, representative, transparent,and honest, I doubt we can make progress.

6. How can we as a society, convince legislators to let science dictate how policy is formed?

7. Isn't it true that when wildlife agencies kill wolves, lions, coyotes and other species in a forlorn attempt to increase numbers of ungulates, that amounts to destruction of public property without justification.

Treves: Public trust assets are not property per se but rather represent a pool of assets in which the public has a sovereign interest. That phrase combines US Supreme Court rulings since 1842 and as recently as 1979 that establish the US wildlife trust doctrine. So yes people who kill wild animals are using the public interest assets for their own private purposes. And when the agency permits such killing for its own benefit (permit fees) or kills wildlife itself, it is again taking the public interest asset. If such private taking and agency taking substantially impairs the corpus of the trust (the whole of the asset) that would violate the trustee responsibility (Illinois central 1892). The questions that arise from this formulation are (a) will courts uphold the common law principle of the wildlife trust, (b) what are the precise duties of the wildlife trustee? (c) what is substantial impairment? (d) who decides?

Elbroch: If you mean that ungulates cause substantial property damage, then you are right. State agencies often spend large amounts of time and other resources attempting to mitigate conflict with deer and elk.

8. Isn't it time to review the notion (never voted on by the public) that elk, deer, pronghorn and bighorn are the first order of wildlife, with carnivores and other species occupying a secondary role, leading to what we have today…our 'war on wildlife'.

Treves: US states rarely put such questions to voters: Rather they leave these issues (the protection or use of a particular wildlife population) to wildlife commissions, legislative rule-making and statutes , and the occasional ballot initiative or referendum put to voters. If your jurisdiction allows a voter referendum or ballot initiative, you can put such questions to voters. The current system of wildlife commissions (a small number of individuals selected by the executive and approved by the legislative branches usually) across the USA leaves a lot of power in uneelected officials who usually have strong financial and non-financial competing interests such as ties to industry or user groups. Also few wildlife commissions are required to be transparent about how they make decisions so many claim to be science-informed when they clearly make judgments informed by their personal or organizational values instead. Furthermore, some commissions will be misled about the science by the state agency that is beholden to special interests. And of course there are hard-working, conscientious, and ethical commissioners who understand they are trustees and seek outside scientific advice when possible.

Elbroch: Yes, it is time to put greater emphasis on the conservation of functional ecological systems and biodiversity to ensure healthy human communities long into the future.

9. The SAG in Colorado focused on wolves future would be dependent on social tolerance all the while focusing on increasing social intolerance. How do we combat this?

Treves: Whether it is Colorado or any other jurisdiction, partisan politics play the overwhelming role. Science is not a weapon, it is the factual basis for understanding the past, present, and future state of the universe. Plus science is a human endeavor and time-consuming process for approximating reality, which sometimes makes errors, self-corrects sometimes, and takes time to reach scientific consensus. In the USA, we have three branches of government that can address injustices: the executive, the legislative, and the judiciary. They each work differently, having more or less influence of majority politics and more or less use of scientific evidence.

10. Decision-makers are often accused of ignoring the science, but sometimes the science is not adequate or reliable. What are the key elements/requirements of science? How does science differ from scientific opinion?

Treves: Please look at the infographic we made to define 'best available science' here LINK before reading the rest of my reply. Scientific opinion is a synonym of 'scientific

interpretation' not the same as everyday opinion. Now dismiss the notion at one extreme that every scientific finding is accurate and dismiss the other extreme that no scientific finding is accurate (and therefore one person's opinion is the same as another's). Neither extreme is accurate. As Naomi Oreskes (2019) puts it in "Why Trust Science?", we trust science when a diverse community of independent scientists who have dedicated their careers and time to scrutinize a result come to consensus (rarely unanimity) that the finding is reliable. And Oreskes reminds us from the tobacco industry, gun industry, petroleum industry, etc. that we should mistrust science when the number of scientists claiming confidence in their results is small, homogeneous, and has a competing interest (such as $) in the finding. So when considering a single scientific article or even a single finding in that article remember it is not necessarily reliable. Scientists are people too and they can make mistakes and have their own values and their own opinions, which can distort their scientific methods, results, and interpretations. No single finding is strong evidence, it must be replicated one or more times by independent investigators and then qualified scientists must come to consensus that uncertainty has been reduced to a level where they feel confident communicating the given result. But when a qualified scientist speaks about their own research methods and interpretations, that usually carries more weight than anyone else's opinion about the same topics. Because one or a few scientists can be in error, we look for scientific consensus on an issue before declaring confidence in the result. Scientific uncertainty is not the same as zero information. Scientific uncertainty tells us how much confidence we should have in a particular result. As the uncertainty diminishes the scientific consensus grows and confidence in the reliability of findings.

Every day (lay) opinions (or the views of scientists who are unqualified on a topic) do not work that way because the holder of the opinion has not devoted the years of study and research to be properly skeptical and self-critical. Scientists spend their time benign skeptical first of their own findings and second of other scientists in their field. That is how science is self-correcting. Every day opinions are not systematic or disciplined.

Dr. Louchouarn: This is a really great question. I would note here that what often occurs in situations in which decision-makers are accused of ignoring science is that decision-makers are using the science they prefer/or just the science they are accustomed to using, while ignoring new or contradictory science. The scientific consensus on much of what we know is constantly evolving and improving, but the science being cited in policy decisions is often outdated. Science does however take time, and we dont often have all the answers right away, but we do have growing bodies of information, and decisions should evolve in tandem. The best science will always be reproducible, transparent, and aim to reduce as many biases as possible. See Dr. Treves' excellent editorial for more on this:
https://esajournals.onlinelibrary.wiley.com/doi/10.1002/fee.2568

11. Can carnivore working groups come up with ways to require specific knowledge/training for official state or governmental wildlife and game commissioners? or at least urge best practices for scientific understanding in selecting these powerful entities?

Treves: Can they? Probably not. Should they, probably yes. It would take legislative or executive action to annul or change commission duties generally. It is my opinion as a student of US law (not a lawyer) that commissioners first should be held to trustee standards, secondly familiar with scientific and scholarly evidence in the activities they regulate, and then trained to discern the difference between value-based arguments and evidence-based arguments. I agree tih Dr. M. P. Nelosn and W. S. Lynn that explicit ethical reasoning is under-appreciated in government decision-making. Why? I'm guessing that possibly because our government is not accustomed to a diverse, pluralistic public wanting a say in how they make decisions or unwilling to allow it.

12. Animal agriculture is the primary driver for killing these predators, what are the policies and the enforcement of laws that animal holders have a responsibility to protect "their" animals? (apologies if this was discussed. I jumped out for a bit)

Treves: I'm not sure I agree that animal agriculture is the primary driver. Protection of livestock is often stated as the primary concern and it is one of them but my research suggests if that was ever true it is not now. Our research suggests competition over deer is the primary reason to kill wolves. I'd like to hear my colleagues' views on which is primary?

Dr. Louchouarn: Most states and jurisdictions do allow protection of livestock animals if attacks are in progress (ie if predators are caught in the act they may be killed by the owner). However, this isn't as common, more often owners find a dead animal and call in the attack or make their own assumptions (usually both). However, to my knowledge, there are no overarching rules about protecting livestock from attacks in places such as public lands. This is something Dr. Treves and I have both written public comments about, urging policies to explicitly require some level of intentional protection to be used by ranchers on public lands using non-lethals before more drastic measures are considered. I do believe people are pushing for this, but as far as I know, it is not widely practiced.

13. Dr. Elbroch brought up Nebraska's reason to hold a puma hunt — to satisfy "cultural capacity capacity." Is this seemingly unscientific term, that's so common, a way for agencies to ignore the growing body of social science relative to wildlife?

Treves: There is no scientific consensus as far as I can see about any definition of carrying capacity other than the biological version (and the devil is in the details of biological carrying capacity too). Early attempts by Michigan social scientists to justify and standardize measures of "social carrying capacity" have been set aside (by scientists) as unreliable because of overwhelming (unintentional?) bias imposed by the

concerns of the researcher, the framing of the questions, and the representativeness of the respondents.

Elbroch: I don't think they are ignoring social science completely–it seems to me they are acknowledging the importance of social values in wildlife management, and placing it before ecology and biology (species health and ecosystem health). It does ignore the social science showing that people in general are increasingly tolerant of large carnivores.

14. How do we convince agencies to emphasize nonlethal methods rather than killing wolves?

Treves: see above about political processes, trusted messengers, and Dr. Bruskotter's link to research on persuasion. I perceive (but I have no data) that the proponents for reform of governance and reform of wildlife decision-making still believe two hypotheses: (a) the information deficit hypothesis or 'educate your way out of a problem'; this hypothesis and the interventions that flow from it seem to assume the current political controversies relate to different levels of information rather than being value-based debates and partisan political debates in which opponents have equally strong beliefs about what is right or wrong.

Or (b) collaboration and compromise will solve our problems. This risks that one side does most or all of the compromising (the marginalized under-represented groups almost always). When those holding power do not compromise as much or more, the debate will be lost by the marginalized groups. I perceive (but I have no data) that the proponents for the status quo and establishment do not share these hypotheses. It is worth remembering that US social justice debates that relate to morality or deeply held values were not resolved by compromise and it's not clear to me how much of a role was played by educating the past wielders of power.

Answered live by second panel.

Questions/Comments About Working/Stakeholder Groups

1. How do we keep stakeholder groups from being taken over by organized special interests that already dominate wildlife governance, leaving out the majority of people who might care about wildlife, but do not have a pathway to be heard?

Treves: Abolish commissions or if impossible reform them. Both moves require one to invest in and trust the elected representative branches of government to serve the majority. Of course that poses a challenge too. In US democracy, the judiciary is the third among equals and as such can sometimes rectify injustices. The US judiciary is the only branch that has a formal structure for counter-majoritarian decisions, namely decisions that protect the minority from the majority.

Elbroch: 1. Transparent, fair, representational selection of participants, and 2. Professional facilitation by individuals without a vested interest in the outcomes.

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3. [After Dr. Elbroch's description of a good stakeholder process] Sounds very much like Washington's Wolf Advisory Group, where scientists who study wolves (from UWash and elsewhere) in Washington come in and present their research to the stakeholder group to inform them as they make recommendations.

Treves: I have heard mixed reviews of the WAG. In general, stakkehodler processes are unjust for the reasons we explained in this article led by Jsoe Vicente Lopez-Bao in 2017 (LINK). I challenge anyone to point to an advisory group that meets these three criteria for fairness: (a) proportional representation of all the public, 9b) impartial representation of nonhuman interests. And (c) impartial representation of the interests of future generations. I predict zero such groups have ever existed in the history of humanity and therefore advisory groups are always unfair (to someone).

4. Advisory groups have been used by many states as another way to justify killing predators and say that "stakeholders" support it. Are you concerned that your comments will be taken by agencies as an endorsement of this tactic?

Treves: I believe this is intended for Dr. Elbroch?

Elbroch: Adrian shares just criticism about advisory groups above under #3, but it's the idea I support–the goal of including the public and more diverse perspectives in wildlife decision making processes. How to protect these groups from manipulation is a real conundrum, and how to ensure true diverse representation in these groups is certainly challenging. But they do provide an alternative to status quo management right now.

Am I concerned about being misquoted or misinterpreted? It happens all the time. We hear the message we want in any speaker and cling to that which supports our current values and beliefs. Thus people misquote or misrepresent people's work all the time. See Dr. Bruskotter's responses.

5. When the agency decides who is on a working group, how can it ever really be impartial or represent diverse viewpoints? How do you keep the agency from just selecting people who are either weak or who will agree with them?

See response to 3 above

Elbroch: This is a legitimate concern and it definitely happens.

6. Not a question but a comment: the effectiveness of stakeholder groups can vary depending upon their structure. I think they work best when 1) representatives of moderate organizations are included, as the most extreme groups are often unwilling to compromise their positions in fear of alienating their membership, and 2) it is greatly helpful to include folks who represent only themselves, not groups, as these folks are often the most willing to compromise or think outside the box to find solutions.

Treves: Social science research by (**Nilsen, E. B., E. J. Milner-Gulland, L. Schofield, A. Mysterud, N. C. Stenseth, and T. Coulson, 2007.** Wolf reintroduction to scotland: Public attitudes and consequences for red deer management Proceedings of the Royal Society B 274: 995-1002.) quantified that representatives of interest groups averaged more extreme positions even than the constituents in their organizations (on either side of the issue). Therefore I tend to agree with the comment above that advisory groups are extremely unlikely to find compromises that are even and just.

Elbroch: I am aware of some groups who signed contracts at the start to commit to compromises and a consensus decision on the objectives. I hope we can continue to test best methods to see advisory groups improve.

7. I can already hear WDFW using the statements from this webinar to pummel wolf advocates into submission: “Randomly shooting wolves must be OK, because the WAG endorses it, and the WAG is ‘scientist-approved.’” Great panel overall, but panelists need to learn more about how some of these groups are being manipulated to prevent change.

Elbroch: As I am ignorant on the details of decisions or recommendations made by WAG, I want to be very clear that I do not endorse any of their specific actions. I support the group process, but as described above these processes are not perfect and they can be hijacked–so they need to be transparent and protected.

9. I work for a state agency, we can't pay for work up front. Projects have to be deliverable or expense based. Food for thought.

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11. Washington’s WAG has endorsed the agency’s strategy of killing wolves randomly from helicopters to teach other members of the pack a lesson. How do you ensure that these groups hear the best available science, and not just what the agency feeds them?

Treves: That was one purpose of this webinar. The rest is up to the political process.

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14. It was disappointing to hear Dr. Elbroch seem to endorse Washington's WAG. I have followed it for many years, and watched the agency use it as a vehicle to impede progress and pretend it is hearing diverse voices. It actually uses it to silence dissent. Wildlife group are a tiny minority, and it operates on a "consensus" basis, with no room for dissent. Worse, there is a gag order that bans any WAG member from publicly criticizing the agency. WDFW kicks people off if they won't fall in line. Tim Coleman was kicked off two years ago because he wouldn't public support the agency's decision to kill wolves for a livestock owner that refused to take any steps to protect his cattle. At the moment, WDFW is using the WAG as an excuse to block a rule to increase WDFW's accountability for decisions to kill wolves. I fear Dr. Elbroch's comments will give them more ammunition to evade any binding rules.

Elbroch: My apologies but I was not briefed on the purpose of this webinar, as with potential regards to WAG and current wolf politics in Washington. I was told it was a webinar on coexistence and asked to present on whether mountain lions impact elk and deer.

As I am ignorant on the details of decisions or recommendations made by WAG, I want to be very clear that I do not endorse any of their specific actions. I support the group process, but as described above these processes are not perfect and they can be hijacked–so they need to be transparent and protected to ensure they function as intended.

15. I just want to call attention to the use of the word "stakeholder". This is a loaded historical word that is hurtful to indigenous peoples.

Treves: Agreed. Stakes in the ground and stakes in betting refer to property and money respectively, rather than to democratic principles of who is represented. In US wildlife trust law all of the public including future generations have a voice.

Elbroch: Thank you, I was not aware of this…doing some research it does seem there are several proposed origins for the word, at least one of which is oppressive.

16. Summary of questions by moderator: We have had a number of questions in the chat and Q&A about Washington's wolf advisory group. A couple people have taken what the panel has had to say as an endorsement of how that group works, and for the

commission to follow its recommendations. Others have questioned whether it fits, because it is 1/3 hunters, 1/3 ranchers, and 1/3 environmentalists, and members of the group are dismissed if they speak counter to agency policy in public. Any thoughts on this?

- Answered live by first panel after the break between panels.

Questions for Dr. Treves

1. Why don't we move the wolves instead of killing them?

Moving wolves often kills them either during immobilization and transport (rare) and after they are released (more commonly). Mortality in Minnesota and Wisconsin after translocation was approximately 75%. Also translocated wolves seemed more likely to attack farm animals. Recall a wolf is a family and a team so loners and individuals torn out of their families struggle to survive, often turning to the most predictable food on the landscape (farm animals) and farm animals may be easier to catch than adult deer when you are alone. Finally, there is no gold-standard (RCT) evidence that translocation protects farm animals better than leaving wolves in place.

See Elbroch & Treves (2023) for more general analysis of the potential consequences of removal of predators LINK

2. Question: Does the presence of stable territory-holding carnivores, or "wealthy" predators, lead to a reduction in prey mortality and behavioral adaptations that benefit the prey, such as increased vigilance and altered behavior, akin to the concept of wealth in a society with reduced income inequality, and can these benefits be passed on to the progeny of prey populations? Definition of Wealth (in the context of the hypothesis): Wealth is defined as the ability of the territory-holding carnivore to secure consistent access to resources and maintain a relatively uncontested leasehold, which, in turn, influences prey populations through reduced mortality, altered behavior patterns, and potential intergenerational benefits.

Treves: There is a lot packed into that question. First, Lamarck's theory of the inheritance of acquired characteristics has been largely disproven since he proposed it in the 18th century but epigenetics and the inheritance of acquired immunochemistry might be exceptions. So I expect the prey of carnivores in a stable territory inherit adaptive traits through natural selection. About stable territories (of wolves), we know they develop multigenerational, complex structures and have higher reproductive success than newly established packs and packs with just 2-3 adults in them. Does that help?

I'm concerned that using the word wealth opens a can of worms. I need to think about it more.

3. Does mitigating livestock depredation (regardless of method--nonlethal or lethal) improve tolerance for wolves?

Treves: I have changed my vocabulary and some of my colleagues have followed suit to stop using “depredation” as jargon and also a word that is value-laden because the first definition in the Oxford English dictionary includes pillage and plunder. So restating the questions, “Do people’s attitudes improve when one helps them prevent predation on their farm animals?”

Almost no one has studied this question in the manner I posed the question (cause-and-effect relationship). My Phd students have studied it (Sam Hermanstorfer, MS and Alicia Alexandra Pineda Guerrero, PhD candidate). It appears the answer so far is yes and no. Some farmer’s attitudes improved, others did not and for those whose attitudes improved, it didn’t seem to matter if we could detect a measurable improvement in safety of their farm animals. They seemed to like being a part of our experiments and this seemed to improve their tolerance of carnivores in their area (did not include wolves in either study).

4. What is the proposed mechanism for the increase in livestock loss following wolf pack culling?

Treves: We proposed two hypotheses in Santiago-Ávila et al. 2018 (LINK) and cited the precedents for those ideas: (a) survivors scatter to neighboring farms in the same township where they prey on moe farm animals because the team – that wolves depend on for cooperative hunting of large prey– has been broken up. (b) newcomers invade the territory after the pack has been weakened by lethal management (again the team works to defend a territory cooperatively and is less capable of such defense when it loses a member). Newcomers might prey on farm animals in neighboring areas because the habitat is unfamiliar.

Farm animals in Michigan and the Upper Great Lakes) are almost all grazed on private fenced pastures, which makes farm animals very predictable in time and space, unlike wild prey. Newcomers and individuals vying for social dominance may profit from a predictable food supply or some other reason farm animals are more vulnerable during such periods.

See Elbroch & Treves (2023) for more general analysis of the potential consequences of removal of predators LINK

5. Has there been attempts to do travelling public education outreach events to talk about wolf benefits, reality of the inefficiency of wolf-killing, and safer methods to discourage wolf presence on ranch property in areas with lack of understanding for wolves to remove the fear/misunderstanding of wolves?

Treves: I travel to speak about our research, yes. Also our field experiments in Alberta, Wisconsin, Colorado, Colombia, and Chile all involve cooperation with owners of farm animals in carnivore range.

6. In places like Idaho where bounties are paid, is poaching likely to increase with very relaxed regulations?

Treves" Yes that is a clear prediction from the six studies I cited. However, when bounties are paid, killing is legal by definition and when legal killing is very frequent, there may be no wolves left (in some areas) to be poached.

7. Does mitigating livestock depredation (regardless of whether lethal or nonlethal) improve tolerance for wolves?

See answer above for non-wolves. I don't know of evidence for this with wolves, although anecdotally the claim has been made ever since Bangs & Shivik (2001) claimed non-lethal methods improved tolerance for wolves.

8. Why not use permits issued to ranchers instead of government control or hunting, to increase the likelihood that the predator killed is actually the one killing livestock?

Treves: This was attempted in Wisconsin. 2 wolves were killed and no one knows if they were the culprits anyway (shooting during the act is vanishingly rare and difficult). Farmers did not sign up in large numbers. Anecdotally we heard they do their work around the farm without a rifle handy and rarely see wolves anyway. Opponents did not like the program because it was perceived as a license to kill any wolf anywhere for no reason.

9. Does selectively killing wolves that prey on livestock raise tolerance of wolves among ranchers? Or are the studies just about widespread wolf hunting?

Trees: We designed focus groups with farmers and asked them about selective removal of wolves by government agents or by farmers themselves – ied by Nrowne-Nunez et al. 2015 cited in my talk LINK. Farmers reported this would increase their tolerance but after it was legalized some of those farmers reported they would still poach wolves and they wanted more wolf-killing through public hunts. From focus groups one cannot estimate if it was a majority of the farmers nor if their tolerance changed quantitatively (that's where the mail-back surveys Treves et al. 2013; Hogberg et al. 2015 improve on focus groups) but I concluded that tolerant behavior had not really improved.

10. Can you comment on whether it would effectively "change pack behavior," reduce predations on cattle, or improve social tolerance for an agency to use a helicopter sharpshooter to kill members of a wolf pack at random, several days or weeks following a predation event?

Treves: In brief, I predict this method of lethal management is unlikely to protect livestock or improve attitudes to anything. Plus it is very costly by financial and environmental criteria.

The long answer is that we need to think hard about the effects – and think mechanistically. I don't think that precise question has been investigated scientifically yet, which means we have to reduce our uncertainty about the answer by drawing inference from related research. First, it seems logical that the wolf mortally injured or killed will not learn anything after it dies. Second, if anyone learned anything, it can only be the survivors right? Therefore, it follows that we need behavioral research to answer the question because the claim that helicopter gunships teach the surviving wolves something is a claim about individual wolf memory, instinct, learned behavior, etc.

What do survivors learn from helicopter gunships? Reams of experimental studies of animals' (including carnivores) reactions to threats from people and form their own wild predators indicates the survivors become acutely aware of the stimuli associated with the stressful, threatening events. Ideally, we want wolves to associate domestic animals with stress and fear but the scenario described in the question is one in which wolves will associate helicopter rotors with stress and fear. The wolves may not even realize humans pose the threat or guns considering the noise of the helicopter and the people concealed within. For example, researchers studying the reaction of animals to tourism have long recognized that vehicles containing tourists are not viewed as threats by wildlife but as soon as the vehicle stops and someone steps out, animals get skittish and try to hide or flee. Wild animals have to be discriminating like that, their survival and successful reproduction depends on it 24-7. Finally, I'd remind readers that non-lethal deterrents create aversion that is causally connected directly to the problematic behavior (such as crossing a fence line or approaching cattle), which tend to be more effective and long-lasting than aversive stimuli unrelated to the problematic behavior such as helicopters and death from above (Shivik et al. 2003 LINK). That is a basic principle of operant conditioning and behavioral aversion known for decades, which is why animal behavior should be more heavily emphasized in wildlife manager training, more so than population ecology*.

In sum, I predict that in the situation described in the question, surviving wolves would view helicopters as dangerous but not farm animals or their owners. That's why I don't think helicopter gunships are an effective method for protecting livestock.

Also, note the only study of aerial gunning of coyotes to protect sheep (Wagner & Conover 1999) was riddled with errors in study design and contained misleading information (web panel 1 in Treves et al. 2016 LINK), which were exposed in a federal court case lost by USDA-WS in Idaho (Western watersheds project et al. v. USDA-Wildlife Services. U.S. District Court Idaho 16 February 2019, 1:17-cv-00206-BLW Doc 22-3). Moreover, proponents of aerial gunning should disclose all financial competing interests so the public can know if their claims are like those of the tobacco and petroleum industries (Oreskes 2019 "Why Trust Science?").

Finally (for effectiveness in protecting livestock), one logical hurdle also stands in the way of killing to resolve conflicts when the killers cannot identify the 'culprits" (animals

who were involved in the killing or adopt the problematic behavior). For helicopter gunships to work, the wolves killed must be the culprits and we should protect the non-culprits. Reasonable persons will want to protect the non-culprits because we want a wolf population that does not attack livestock that are well managed and protected by their owners. So each error (a non-culprit killed) might exacerbate the problem. The only good wolf is a dead wolf' has been disproven repeatedly and for decades (Linnell et al. 1999; Treves et al. 2002, etc.). Abundant research shows that we humans are inaccurate at targeting the culprit animal(s), especially when we act weeks later in areas far from a conflict site (Sacks et al. 1999; Knowlton et al. 1999; Treves & Naughton-Treves 2005 and references we cited LINK**).

The question also asked if helicopter gunships can raise tolerance for wolves. As described by eight studies by seven different lead authors summarized in my talk (LINK), the general public will value wolves less if the public perceives the government is saying there are too many wolves or they pose too many problems or the government needs help killing them. Lethal management conveys one or more of those messages to would-be poachers and to the average person reached by a survey. I recommend thoughtful, adult deliberation about balancing different people's needs. No one needs a wolf killed except in cases of immediate threat to human safety; livestock owners only need their farm animals protected and the best evidence supports non-lethal methods. Ungulate hunters do not need wolves killed, in fact the opposite from evidence presented by Dr. Elbroch. Considering the benefits of reduced ungulate-vehicle collisions, improved forest and vegetation health, more people would benefit from more wolves alive.

Keep in mind that policy debates always have multiple sides, so any intervention must weigh the opposition it will trigger. Are helicopter gunships supported by the majority of the public? If not, any improvements in tolerance for wolves among a handful of trigger-happy individuals (which I doubt) may be offset by intolerance by millions of people for the agents who implement and the policy-makers who allow it.

In conclusion, I recommend all wildlife commissions carefully scrutinize the costs of helicopter gunships. That scrutiny should use extreme prejudice because none of the scientific evidence supports effectiveness (see the suspicious errors and inconsistencies in the case of Wagner & Conover 1999 above) and the side-efefcts of this method have not been stated clearly and explicitly.

*Behavior is not generally the expertise of wildlife managers trained in population ecology–as noted by Dr. Bruskotter's comments during his talk; more training in behavioral ecology will be needed before agency scientists are qualified to address individual behavioral reactions and variations. I feel qualified to consider these questions because I have published several dozen scientific articles on predator-prey behavior from my PhD research and post-doc work (although not with wolves).

Treves & Naughton-Treves 2005 and references therein – please see below for evidence that WDFW read (some of) the latter article but cherry-picked information it liked rather than accurately summarizing our work).

11.) Very recently, the WDFW quoted your 2005 book chapter with Dr. Naughton as stating, “...short selective removal of problem animals by government agents may be necessary to protect wildlife from extinction via widespread, illicit retaliation”. Comments?

Treves: That 18-year-old article proposed the hypothesis that we later tested with data on human attitudes (we found the opposite and, yet later, tested with data on survival of collared wolves in five state populations (and found the opposite). I was regrettably repeating the assumptions of the USFWS and Wisconsin DNR in that chapter. We now have evidence that lethal management increases illegal killing. Science makes progress and that 2005 article was wrong and the WDFW was wrong to cite it that way (out of context as you will see below) and they perpetrated a breach of scientific ethics (called selective citation and unfair handling of evidence by the National Academies in their 2017 report entitled “Fostering Research Integrity”). The WDFW should immediately correct this breach of scientific integrity and present the up-to-date evidence in a complete and honest summary of Santiago-Ávila et al. 2020, 2022; Santiago-Ávila & Treves 2022; Louchouarn et al. 2021). So that you can see they quoted us out of context I provide additional text from the same 2005 chapter below

“The relationship between the control method and illicit killing by stakeholders must also be considered and quantified. … Given uncertainty about stochastic causes of mortality in most large animal populations, we suspect that erring on the side of caution is the best way to maintain wildlife population viability for certain species… Achieving this coexistence will entail technological innovation, including developing better non-lethal deterrent methods, more accurate identification of problem animals and conflict sites, and improved monitoring of the impacts of control programmes." and

”Also, governments must control other sources of wildlife mortality lest government culling be additive with private, illicit killing and together undermine wildlife population persistence." and

"Although killing a problem animal may temporarily placate local complainants, it does nothing to instil ownership or a sense of responsibility for the species among rural citizens who will probably continue to resent the presence of ‘the government’s animals’" (that last phrase is a direct quote from a respondent in Wisconsin and a respondent in Uganda, which we quoted to illustrate the similarity of attitudes across continents. It is not a relationship to animals that we endorse.

Questions for Dr. Elbroch

1. Do you see a difference in prey selection between antlered ungulates versus nonantlered? Bucks versus does?

Elbroch: In the 2 studies I looked at this, cats selected female deer in approximately the proportion they were found on the landscape….there are typically more does than bucks, so this isn't entirely unexpected.

2. Could dispersing mountain lions be eating more porcupines as they disperse because porcupines are more common in the forested areas they have to move through between water sources?

Elbroch: Here where I am now on the Olympic Peninsula in Washington, porcupines are not common–here dispersers eat lots of raccoons. I'd guess this diet of porcupines and raccoons reflects ease of detection (are prey easy to detect?), abundance (meaning where they are common, they will eat more of them), and ease of capture. Porcupines are loud in debris and slow.

3. Are there differences with which Mountain Lions enter towns and perhaps eat pet cats and dogs?

Elbroch: There is little research specific to this question…Blecha et al. 2018 suggest mountain lions enter risky neighborhoods when they are hungrier–as they become hungrier, they take bigger risks. (Blecha, K.A., Boone, R.B., Alldredge, M.W., 2018. Hunger mediates apex predator's risk avoidance. J. Anim. Ecol. 87, 609–622.)

We are studying this on our Olympic project and will report results soon!

4. Do you think that there is difference between male and female hunting tactics?

Elbroch: I don't know.

5. When ungulate populations are below carrying capacity, and according to your presentation, carnivore depredation is 'additive", what 'Right' does a wolf or mountain lion have to eat its natural diet without being killed for being 'additive'?

Elbroch: As I said, "additive" is not necessarily the end of the world and reflects a spectrum of potential impacts on ungulate populations. And my point about hunted ungulate populations is that they are almost always below carrying capacity…so

predation is likely to appear additive. When analyses exclude the impacts of human hunting, I am of the opinion that presenting carnivore predation as additive is somewhat misleading.

Your question of “rights” implies values that I’m not sure how to interpret–and I don’t want to misunderstand your question. I would say that I believe mountain lions have the right to eat prey, and that they require prey to survive whether their predation is additive or compensatory.

6. With one interruption, this may have been covered: Stats should always include that predators kill only the weakest or oldest, but human killing (especially "trophy") kills the genetically strongest and impacts the health of the species.

Elbroch: Mountain lions do not select the weak or old, as a general rule. They target younger, more vulnerable ungulates more than any other class, and any other ungulate that opportunity makes attractive (where land and circumstance give the cat an advantage that it capitalizes upon). Sometimes mountain lions do kill older animals or sick ones as well. Whereas other carnivores have been shown to exploit weaker animals, this is not generally true of mountain lions.

7. Any indication whether livestock operator awareness and tolerance may be improving for older resident pumas who might tend to choose native prey over livestock?

Elbroch: I don’t know. Certainly I know some older livestock owners who are very tolerant of mountain lions as neighbors, but I am unaware of research that presents the trends of tolerance.

8. In Klickitat County WA we have cougars being lethally removed for eating domestic cats. There are many feral domestic cats in rural areas, so cougars learn that these are prey and are then drawn closer to people who keep barn cats and pet cats. How can we address the proliferation of feral cats and its effects on cougar mortality that we are seeing?

Elbroch: Deer feeding, raccoon feeding, and cat feeding can be addressed via municipal codes, as well as state policies. These are great targets to begin to mitigate the potential attractions for mountain lions in diffuse towns and communities.

9. Does killing mountain lions decrease killing of pet and livestock, and dangerous encounters with people? I have heard it actually increases conflicts, but if that is true, how does that work?

Elbroch: No, it does not protect pets and livestock– answered in the Q&A.

10. Does killing mountain lions make people less safe?

Elbroch: We do not know. One could speculate this could be true based on the research which highlights that younger, hungrier animals are more likely to have negative interactions with people, and that hunting generally reduces the average age of mountain lions in a population and increases the proportion of the population that is young. I present this as a hypothesis in the book, *The Cougar Conundrum.*

Questions for Dr. vonHoldt

1. Specifically which agencies does Dr. Bridget work with?

   Dr. vonHoldt: I work with NPS, USFWS, and tons of state level agencies NGOS, and furbearers for wild canid genetic work.

2. Could you discuss the potential of "genetic swamping" of Northern Gray wolves and Mexican Gray Wolves with the reintroduction of Wolves in Colorado?

   vonHoldt: There is no swamping as the term was originally coined. This usually has a context of hybridization, admixture, and genomic dilution. The Colorado reintroduction plan is very likely to be releasing wolves that have the same heritage and genetic lineage as is already found in the northern Rocky Mountains and Pacific Northwest.

3. Is that N or Ne?

   Dr. vonHoldt: Census size or abundance = N; effective population size = Ne. I'm not sure whick slide you might have been referring to but let me know and I'll try to follow up.

4. Can wolves sense/tell which wolves have more genetic diversity and if so, how?

   Dr. vonHoldt: They can! Wolves are very good at identifying relatives and which wolves they pick as mates. Some of the genetics are called MHC genes (which have also been studied in humans) but we also know that wolves use lots of traits to narrow down and possibly pick their mates (which are unrelated, should they have the choice!).

5. As concerns increase regarding how many wolves actually remain Montana, especially in response to the liberalized and aggressive regulations, thus the push is for an actual count, how do we ascertain the effective population size is incorporated and prioritized?

   Dr. vonHoldt: Good question. Publishing the genetic work helps, and I try to be as active as I can be in these discussions. These aspects are already built in to much of the modeling (population viability analysis modeling) but the genetic effective size (Ne) is yet another aspect that can help refine the modeling effort. The more our predictions reflect reality and complexity of wolf lives, the more

likely we can formulate successful management and recovery plans for long-term persistence and avoiding the delisting/relisting/delisting/relisting cycle.

6. In Idaho the Fish & Game agency wants to reduce the wolf population from about 1500 (controversial) to 500. If there succeed, how would that effect heterozygosity?

· Answered live.

Questions for First Panel

1. Opinions on the effectiveness of wolf culling in northern Canada to help sustain the caribou population?

Treves: Here is what Treves, Elbroch, Bruskotter 92024) wrote (LINK) on this and related subjects:

"Governments have for a century or more justified killing grey wolves to increase hunting opportunity for ungulates, such as elk (*Cervus canadensis*) and deer (Leopold 1933 reprinted 1986; 1949; Harbo and Dean 1983; Theberge and Gauthier 1985). Grey wolves are capable of reducing wild ungulate populations (Ripple and Beschta 2012); however the effect of grey wolves on ungulate abundances depends on other factors, such as ungulate vulnerability driven by winter severity (Vucetich and Peterson 2009; Peterson *et al.* 2014), local primary productivity (Melis *et al.* 2009), the abundance of ungulates relative to their carrying capacity (Ballard *et al.* 2001) , the diversity of the local carnivore guild and potential for multiple ungulate predators (Griffin *et al.* 2011), and the abundance of alternative prey (i.e. apparent competition (Wittmer *et al.* 2005). A recent meta-analysis of the outcomes of carnivore removal on geographically diverse ungulate populations estimated that predator removals resulted in increased juvenile survival and recruitment on average, but equivocal effects on average adult ungulate abundance, which should be the metric that determines if efforts to increase huntable population size or hunting opportunity succeeded (Clark and Hebblewhite 2021). Also, it was not uncommon for counter- productive effects lowering ungulate abundance after predator-killing (Clark and Hebblewhite 2021). A meta-analysis of female elk survival from western North America (Brodie *et al.* 2013) concluded that the best way to increase ungulate abundance was instead to decrease human harvest rather than predators. Indeed, the theory of density-dependent growth of ungulate populations provides an explanation why killing a few predators could diminish ungulate numbers, "Female deer productivity is related to habitat quality. Habitat quality tends to decrease over time with increased deer density. As a result, it is entirely possible that a denser deer population will actually produce less young per year, and hence have a lower potential yield." (Martin 2023). Indeed, the Isle Royale long- term study of moose and wolf dynamics seems to prove that habitat quality and climate are far better predictors of abundance than wolf numbers while we still lack strong theory to predict the

short-term effects of any of those variables (Vucetich and Peterson 2009). The exceptions to these general patterns are predator effects on small ungulate populations. Predation can harm rare ungulate populations via apparent competition. However, the underlying circumstances that lead to apparent competition are generally created by anthropogenic influences on ecosystems (Wittmer *et al.* 2005). Even in cases of rare ungulates, however, intensive grey wolf killing must be maintained to increase ungulate population growth rates. For example, Hervieux *et al. (*2014) in a controversial analysis claimed that killing 841 grey wolves over 7 years, (approximately a 45% reduction in mid-winter wolf abundance), was sufficient to increase population growth rates of endangered woodland caribou in their study area, but insufficient to increase caribou abundance. Critics of that study have questioned many aspects of that claim, particularly the mistargeting the major sources of caribou mortality or misidentifying the true causes of population decline (Proulx 2017a; 2017b). Reports from all U.S. states with grey wolf populations indicate that opportunities to hunt wild ungulates have not been diminished statewide by increased wolf populations. Indeed, recent records from Idaho, Montana, and Wyoming indicate that the number of elk killed by hunters in recent years is stable to increasing in those 3 states, as are elk populations. Data from Idaho, Montana and Wyoming were summarized here: (Center for Human- Carnivore Coexistence 2020). In Wisconsin, the 35-year period from 1975-2010 saw the state deer population grow from 600,000 to >1 million (Waller and Reo 2018), while the wolf population grew from 0 to 700 approximately (Wiedenhoeft *et al.* 2020). Also, hunters took 200,000 deer in the 1980s as compared to 500-600,000 in the 2000s (Waller and Reo 2018). Collectively, these data and the scientific studies suggest that the positive effects of killing wolves on wild ungulate abundance are slighte, may be negative in reality, and remain unpredictable."

2. Since Dr. Treves mentioned the "silver standard" regarding many studies surrounding large carnivore control, I was wondering if it's possible to design double blind studies (i.e., meet the "gold standard") to evaluate effectiveness of large carnivore depredation (as an effort to find effective and affordable alternatives to lethal predator control)?

Treves: I believe it is. See this article (LINK) for our design of such an experiment, now we need the funding and permission from a government.

4. What is the evidence of wolves impact on cougar populations?

65. Does compensating farmers and ranchers for verified kills, change attitudes toward predators?

Treves: See this study (LINK) by Dr. lisa NAughton for correlation analysis of the effect of compensation on attitudes to wolves. I am not aware of a gold-standard study of the effectiveness of compensation for raising tolerance. Also see Dr. bruskotter's lab paper (Slagle et al. 2013) on experiments to change attitudes to Ohio black bears.

Questions for Dr. Louchouarn

1. Have there been any research done on reducing predation on livestock using electric fences?

Dr. Louchouarn: Yes, a good amount has been done in germany. The German government actually requires electric fencing in many cases before it will consider providing payments for lost livestock (it helps that they also subsidize the implementation of this fencing). Here is a link to a literature review where they mention electric fencing for wolves: https://www.sciencedirect.com/science/article/pii/S2351989419306225

And here is one about bears: https://www.nature.com/articles/s41598-020-72343-6

Electric fending is particularly useful for bears, but its been shown to be effective for wolves as well. But keep in mind that the usage of these tools will be limited by space. Grazing in places like Germany is on much smaller pastoral scales than in north america, making electric fencing more feasible. And often, bears are being deterred from stationary resources (ie. beehives, orchards) which makes them easier to surround in electric fencing.

Treves: Also see this study of the effectiveness of electric fences against wildlife generally. **Khorozyan, I., 2021.** Dealing with false positive risk as an indicator of misperceived effectiveness of conservation interventions. PLoS One 16: e0255784. https://doi.org/10.1371/journal.pone.0255784

2. How does time figure into the definition of effectiveness — i.e., does duration matter?

Treves: Just to clarify the word “effectiveness” in the majority of this field has been defined and measured as livestock injuries or deaths over time. Most studies have been short-term (reviewed by Jhorozyan & Waltert 2019). The duration of effect is a separate measure which has been less studied.

Dr. Louchouarn: we did discuss this in the panel, but just to add here: it does. Many tools that rely on scaring predators with their strangeness (ie. lights, fladry etc) will lose effectiveness over time as predators habituate to them and learn that they wont actually hurt them. The best use for these methods is a targeted approach which uses these tools during high risk periods, then removes them, keeping them new and strange for the next time they are used. As for some of these other methods like low-stress range riding and changing of calving season, these methods are meant to reduce the attractiveness of herds, and if herds can scare predators off on their own, they are able to reinforce the effectiveness. Ideally these should gain more effectiveness over time as livestock handlers become more knowledgeable, though there is still much to learn about these methods.

3. One of your 1st images, of the number of studies for lethal and nonlethal, did this include all the various methods you’ve discussed and for which livestock and which predators? Thanks.

Dr. Louchouarn: Yes, this study was a meta-analysis (a study of studies), which just means they pulled together results from 4 different literature reviews and hundreds of scientific articles. Here is the study I cited: https://faculty.nelson.wisc.edu/treves/pubs/van%20Eeden%20et%20al.%202018.pdf

You can find the four studies they cite, but you can also glean most of the answers about the different methods and carnivores studies by looking at the two excellent figures and the tables at the end which list all of the studies, what tools were tested and on what carnivores.

4. Benton County, Oregon Agriculture & Wildlife Protection Program (AWPP) non-lethal deterrents grant recipients in the Oregon Coast Range (30+ livestock operations) have experienced no livestock losses during the first six years of the program. This is a region with a robust cougar population and program participants routinely observe carnivores on their farms:

https://www.youtube.com/watch?v=bTa8IzuZS_ohttps://www.co.benton.or.us/awpp/page/about-awpp

Trreves: I have long been supportive of the Benton COunty program!

5. How do we address an agency that gives lip service to nonlethals (but does not require people to use them effectively) and then proclaims they don't work? A lot of ranchers believe them and think killing is the only way.

Dr. Louchouarn: This is going to be difficult, but from what I've seen, rancher to rancher communication and information sharing seems to be a big one. Groups like the Working Circle and the Tom Miner Basin work hard to share information and help ranchers learn from eachother. They also bring in scientists to help teach ranchers about correct implementation. Going straight to the ranchers and teaching them (with any additional funding that can be used for that purpose and to help take the burden off the ranchers) will trickle up to the agencies. In some cases perhaps the agency intentionally doesn't try to use non-lethals, but in others they simply don't have the capacity to do a good job on this. Helping to create that capacity in whatever way we can seems like a good place to start, and a good way to improve collaboration between conservation and ranchers.

6. How can the science being cited this morning be injected into the science generated by wildlife department biologists to impact future decisions about wildlife species?

Dr. Louchouarn: first, I think we need to hold all scientists (either government or not) to the same standards of reproducibility and transparency. Too often government scientists do not share their data (which all scientists should do, but especially publicly funded

scientists), and their methods are often non-reproducible, non-transparent or somehow biased. Why this is likely has more to do with capacity than intentional scientific malpractice. However, we need to ensure that the science being produced by wildlife departments follows the best practices for scientific methods and integrity.

Treves: Fr. Louchouarn put it very well. The first principle of scientific integrity and the first principle of the movement for Open Science is transparency. That means assumptions, methods, data, results, and interpretations should be open to scrutiny. Without that they are not reproducible (one cannot replicate a study). Irreproducible results are not scientific. Any jurisdiction with a best available science requirement in regs or statutes should pressure all scientists to meet the demands of the Open science movement, which includes journals subscribing to the Committee on Publication Ethics (LINK) and its requirements for transparency, correction, retraction, and rigorous review.

Questions for Dr. Bruskotter

1. Our commission's approach to intolerant people is to give them what they are demanding. How do we counter that?

2. How can the science being cited this morning be injected into the science generated by wildlife department biologists to impact future decisions about wildlife species?

3. How do we address the tendency of commissions to try to satisfy the demands of the angriest people, because commissioners are afraid of getting yelled at? Do we need to be angrier to be heard? Should the least tolerant people control wildlife policy?

   · Answered live

4. Why are quantitative studies on attitudes toward large carnivores largely based in the global north? Is there any such scholarly documentation (timeline which Jeremy presented) that exists from the global south that can help explore alternative ways of understanding tolerance?

5. The graph showing correlation between intolerance for outgroups and approval for lethal management of carnivores was somewhat alarming. Can you pls provide the methods (question phrasing) and the sampling frames? Also would you pls interpret what the correlation might mean and alternative explanations?

6. Are there other studies like Slagle et al. 2013 in which researchers experimentally intervened to influence tolerance for carnivores? Can you summarize the conclusion of that study and your current thinking on this issue please?