KEYNOTE ADDRESS: Transplants Are Not Enough

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ABSTRACT: Recovering populations of bighorn sheep and mountain goats has relied almost exclusively on transplanting animals from healthy populations into habitats from which they have been extirpated. This approach remains key to population recovery, but new knowledge of interspecies interactions has conclusively demonstrated that ecosystems are far more dynamic than previously understood. Human use of fossil fuels has resulted in altering both weather and climate regimes worldwide. Increases in average temperatures of both the atmosphere and ocean water have altered creation and impact of storms and drought, resulting in ever greater risks of damaging storms and wildfires. Climate changes are also altering the interactions and even survival of some plants and animals. It is increasingly critical that wildlife managers interact with their counterparts in land management agencies to develop coherent and updateable ecosystem management plans that address newly-developing risks and management responses as global climate changes occur. Only by acknowledging occurring and potential changes in climate can managers prepare to deal with extreme events and maintain healthy, connected, and genetically diverse populations and ecosystems.

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Despite what you have just heard in that introduction, I am (I hope!) one of you…that is, someone who dearly loves wild places and wild things. I grew up in a household where hunting was more than tradition- if my father wasn't successful in filling his tags for deer and elk each fall, our diet for the following year was mighty shy of meat. I grew up reading *Field and Stream* and *Outdoor Life* magazines, and my heroes were hunters like Jack O'Connor and Ted Trueblood. Not surprisingly, I chose a career in wildlife sciences. My early "hands-on" experience included game surveys and hunter check stations, and later, research on mule deer, elk, and pronghorn antelope in Oregon before returning to earn a doctorate studying bobcat and coyote ecology in Oregon's Cascade Mountain range. I also had the privilege of working with Dr. Jack Ward Thomas of the USDA Forest Service on the book *Elk of North America* (Thomas and Toweill 1982).

I began conducting research on California bighorn sheep with the Idaho Department of Fish and Game in 1984. A race of Rocky Mountain bighorns, California bighorns occupied rocky canyons in the sagebrush scablands of the Great Basin but were largely extirpated by pioneers and grazing by domestic sheep by the 1920s. Recovery efforts were well underway, but many opportunities to transplant bighorns into southern Idaho remained when I began my studies in the 1980s, with an eye toward continued restoration of populations.

You may have heard of the Law of the Theater: *where you sit influences what you see*. I learned the truth of that as I occupied a number of different "seats" in Idaho, all somehow related to bighorn sheep restoration. My responsibilities shifted from research to management when I was selected to supervise development of Statewide Species Plans for all terrestrial wildlife in Idaho, and later, during 12 years as program lead in developing statewide and national environmental policy issues. Whether mining, energy development, logging, or other issues, many of the topics I dealt with involved bighorn sheep. One particularly controversial issue was a proposal to develop a military training range over critical bighorn sheep habitat. As program coordinator, I also had the opportunity to serve on the steering committee of the White House Advisory on National Climate Change for the Rocky Mountain and Great Basin Regions under President Clinton. Finally, in 2000 I returned to my first love: statewide supervision of bighorn sheep and mountain goat management and restoration efforts, a position I retained until my retirement 12 years later.

It was during my time as Wildlife Policy Coordinator that, with contributions from some of you and from many of your predecessors, Dr. Valerius Geist and I edited *Return of Royalty: Wild Sheep of North America* (Toweill and Geist, 1999). That project was

prompted by discussions among many of us in the Northern Wild Sheep and Goat fraternity that a common reference was needed to share knowledge relative to bighorn sheep distributions and numbers. For the first time, it documented the efforts of all of us in recovering bighorn sheep to historic ranges across the continent…and as the book summarized, the success of transplants in restoring those populations.

Today we are gathering to discuss the theme of "recovering bighorn sheep and mountain goats in a changing environment"…and perhaps the most important contribution I can make as an official "ROG" ("Retired Old Guy") is to let you know that "transplants are not enough."

Looking back at *Return of Royalty*, it becomes obvious that virtually all of us "stayed in our own lanes"—that is, our transplant operations fell fully within the authority of our state agencies. Idaho Code states, for example, *"All wildlife…within the state of Idaho is declared to be the property of the state of Idaho. It is to be preserved, protected, perpetuated and managed."* It seemed then that the key to recovering bighorn sheep and mountain goats was as simple as returning them to suitable (and still available) habitat. And it worked!

Transplants, moving animals into formerly occupied but now vacant habitat, often "works" if the criterion is simply survival. It is a simple metric, and if the habitat is largely unchanged, it may well result in recovery of populations. Despite our successes, however, we got a few things wrong, and those are things I am here to discuss. "Restoration of populations in a changing environment" is a different, long-term objective, one that not only demands transplants, but which also considers current and potential changes in the habitats animals require.

The first thing we got wrong was a belief that the vegetative component of habitat structure was stable, controlled solely by geology and a stable climate and thus, relatively immune to change. Many of our historic transplants considered known changes in habitats, such as introduction of livestock (typically cattle or domestic sheep) and associated competition for available forage. Although there was concern about invasive, non-native plant species such as cheatgrass and buffelgrass that had potential to reduce forage for native wildlife, few plans considered potential alterations to habitat, such as wildfire. While those issues were not ignored, management to address them typically was a responsibility of our federal land management agency partners such as the USDA Forest Service and USDI Bureau of Land Management, agencies guided (in the United States) by a number of prescriptive laws concerning environmental protection, including the Multiple Use Sustained Yield Act of 1960, the National Environmental Policy Act of 1969, the Endangered Species Act of 1973, and the National Forest Management Act of 1979. Those agencies also had administrative jurisdiction over uses of the public lands that might compete with wildlife, such as grazing…and although they were partners in many transplants, they were not always a part of transplant efforts.

We now know our concept of environmental stability was a gross over-simplification. We began getting hints of that fundamental misconception after Paine (1966) and others confirmed that biologic communities were in fact very dynamic, in large part regulated by "keystone species." Keystone species were often dominant predators (such as wolves) or herbivores (such as African elephants) whose actions exerted a disproportionate impact on community composition, that is, which animals can co-exist in any given environment, and in a series of interactions, which plants thrive and which are eliminated.

As policy coordinator for Idaho, I was involved with reintroduction of wolves, a keystone species, into the Yellowstone National Park ecosystem in 1994. I watched as predation by wolves on wild ungulates including bison, elk, and deer resulted in those species learning to avoid grazing (and potentially attracting attention of wolves) in open habitats where risk of predation was greatest. Reduced grazing pressure along streambanks and in open meadows allowed vegetation to flourish, slowing the flow of water in streams, many of which had become characterized by stream bank erosion. Reduced grazing along streams allowed riparian plant communities to re-establish. Communities of willows and other riparian plant species subsequently rooted and flourished, thereby providing habitat for beavers, songbirds and other species long absent from these areas (Wilmers et al. 2003). The speed at which these changes occurred was remarkable, driving home the message that no species, regardless of its ecological role, can be removed or restored without affecting every other part of the system. While some ecosystem changes are dramatic, others less obvious may trigger change within biotic ecosystems…and

that those changes may occur very rapidly, within just a few years.

In short, everything IS, in fact, connected to everything else…and loss of a single species, keystone or otherwise, has the potential to rapidly alter an ecosystem. Just so that no one misunderstands, transplants remain a critical component of wildlife recovery…but transplants may not be enough to secure wildlife recovery in a dynamic environment. In a changing environment, advance planning for transplants must include land management partnerships to develop plans to addresses not only wildlife but also goals for plants and habitat management (including grazing allocations) with those management plans subject to periodic review and revision as changes become evident…which brings me to my second point.

We now know that climate itself is changing, slowly but in ways predicted more than a century ago. The past 12 months were hottest recorded in human history…and the primary cause was human use of fossil fuels. Ever since the Industrial Revolution humans have mined solar energy accumulated over millennia as oil, gas, and coal. Releasing that stored energy as fuels results in also CO^2 and other vapor by-products of combustion into earth's atmosphere. Those "greenhouse gases" (or GHGs) accumulate in earth's atmosphere, trapping heat that might otherwise have been re-radiated into space, ultimately warming the atmosphere of earth. Although greenhouse gases are invisible and seemingly insignificant, the amount of atmospheric warming has increased dramatically as the number of humans on earth has increased … just since 1970 earth's human population has doubled to an estimated 7.8 billion people and may reach 9.9 billion by 2050 (Bradshaw et al. 2021). Already, humans alone comprise an estimated 35% of the total biomass on earth (Bar-On et al. 2018). Virtually all of those people rely to some degree on that stored fossil fuel energy to cook their food, heat their homes, and to provide energy to power their travel. Much of the heat derived from decades of human use remains trapped in the earth's atmosphere or absorbed by earth's oceans. As the atmosphere and oceans warm, energy powers and speeds global currents of air and water caused by temperature changes and by the rotation of the earth, resulting in increasingly chaotic disruptions in weather systems.

Examples of those disruptions that have occurred in just the past 12 months have included rising sea levels associated with accelerating loss of glacial ice in polar regions and among the high mountains, directly affecting some habitats used by bighorns and mountain goats. Water released from melting ice is now threatening some major coastal cities and harbors around the globe. Ocean waters, warmed by both sunlight and a blanket of warm atmosphere, have increased to temperatures never previously recorded in human history, and have been implicated in the devastating die-off of crabs in the northern Pacific Ocean. Warm oceanic waters threaten coral reefs in tropical waters around the globe. Warm air can hold more moisture as water vapor, and when warm, moist air flows over continental lands, moisture may be released suddenly in torrential downpours, some followed soon after as now-dry warm winds blow across the land. If those winds blow across dry lands laden with potential fire fuel, massive wildfires may result such as experienced in Western Australia in 2023 and again last March when a massive wildfire burned over an area of 1.1 million acres in Texas and Oklahoma.

These events and more are consistent with predictions made by climate scientists as potential effects of atmospheric warming a century ago. In 2015, concern about potential effects of global warming resulted in nearly 200 countries signing an agreement in Paris pledging to reduce greenhouse gas emissions by as much as possible and to remove pollution from the atmosphere to keep atmospheric temperature increases to less than 1.5^o C (2.7^o F) below historic averages and to maintain that average over a twenty-year period, while achieving "net zero" further emissions (United Nations 2016).

Countries are struggling to create regulations to cap average atmospheric warming at 1.5^O C. Earth's average atmospheric temperature exceeded 1.5^O C every month from February 2023 through today, and scientists predict that concentration of greenhouse gases in the atmosphere will continue to increase, even if humanity stops using fossil fuels entirely before 2030 (Burke et al. 2018). As a result, even if all signatories meet their commitment to the 2015 agreement to reduce greenhouse gas emissions, temperatures may increase by as much as 2.7–3.1^o C (4.8–5.6^o F) by 2100 (Rogelj et al. 2016), and one of the most damaging, methane, is not under direct human influence but is being steadily released as

tundra permafrost thaws. Despite this, Ritchie (2024) believes that atmospheric data recently suggests that temperature increases can be limited to levels below 2° C (3.3° F) above the historic average.

Despite pledges of the Paris Agreement, few countries have been able to implement regulations to cap atmospheric warming. A study posted earlier this year indicated that emissions from use of fossil fuels have in fact increased since 2015, with just 57 companies linked to 80 percent of greenhouse gas emissions since 2016. The biggest producers included ExxonMobil, Shell, BP, Chevron, and Total-Energies, each of which was associated with more than 1 percent of global emissions.

In the United States, the Securities and Exchange Commission (SEC) last month (March 2024) issued a hold on a final Climate Disclosure Rule two years in the making. The Rule would require publicly traded companies to report their greenhouse gas (GHG) emissions and environmental impact along with their required annual financial statements. In other words, businesses would be required by law to disclose how they assess, measure and manage climate-related risks every year. That legal hold was implemented based on no less than 10 lawsuits, based in part on claims that the SEC lacks regulatory authority to require such disclosures, and further, that such regulation would, quote "be harmful to business interests" unquote. Opposing arguments by environmental organizations argue that the Climate Disclosure Rule fails to adequately address issues of concern, including emission reduction targets. The stay is temporary, while judges evaluate competing claims.

The United States is not alone, the entire European bloc of signatories to the Paris agreement have also been unable to implement measures to keep global atmospheric temperature increases within the proposed 1.5° C cap. That may soon change, however: the European Union recently recognized a healthy environment as a basic human right, making companies contributing to atmospheric warming legally liable for damages. Canada is slightly ahead with its federal carbon price program, which has reduced emissions by about 8 percent by taxing use of energy derived from fossil fuels such as gasoline.

Does that mean there is no hope? No, not at all. There ARE challenges, and the point of "detour" into climate sciences was to emphasize the second reason transplants are not enough to recover populations of wildlife: climate change is coming, and likely to increase to very close to the 1.5° C level proposed as a recommended cap (Ritchie 2024). Based on extensive analysis, Ritchie (2024) believes we still have both time and planetary capacity to cap global warming and create a sustainable human environment.

Many of the adverse impacts associated with climate change over the past twelve months were related directly to issues we can control. For example, increased risk of the catastrophic wildfire driven by high-speed, dry winds across a continuous mat of tinder-dry can be dramatically reduced by addressing fuel load on the landscape and system of potential firebreaks.

Those of us particularly concerned about restoration of bighorn sheep and mountain goats are fortunate, in that much of the critical habitat for those species is rugged and both inhospitable for human development and unsuitable as cropland … but that does not mean "unaltered." Remember the "three Ps" of Idaho's Code: Preserve, Protect, and Perpetuate. Transplants are not enough to recover wildlife populations in a changing environment if we fail to fulfill each of those charges, because RECOVERY implies long-term restoration.

To recap, in order to PRESERVE wildlife, wildlife managers must work closely with managers of landscapes to develop wildlife recovery plans, and in some instances address past changes. That begins with the obvious, identify changes that may make habitats unsuitable for bighorns and mountain goats and restore them if possible. The most obvious of these is likely vegetation change caused by invasive plants or grazing by livestock. Those changes, where needed, must be made by a team composed of both wildlife and land managers, and documented in wildlife recovery plans.

To PROTECT wildlife in a changing environment, recovery plans must address potential climate variability. Management plans will need to focus on protection of native plants as well as wildlife, and on reduction of known risks, such as invasive non-native plants, accumulation of potential fire fuel loads and fire risk, and seasonal fluctuations in rain and snow. Wildlife and land managers should evaluate the potential to develop water catchments or springs, distributed across the species range, both to hold water on the landscape to provide for plants, wildlife, and groundwater recharge, and to reduce risk of unseasonal erosion. The Wildlife Society published a

Wildlife in North America with guidelines for wildlife managers (The Wildlife Society 2004).

Wildlife plans must seek to PERPETUATE wildlife and habitat by incorporating land use guidelines in management plans. In 2021, about 16 percent of the world's land was designated as a 'protected area' such as a reserve, refuge, park, or wilderness, meeting the goal of the United Nations for protection of earth biodiversity. However, at the 2015 Convention of Parties (COP), countries agreed to increase the goal for protected landscapes to 30 percent by 2030. Even when not designated as "protected area," wildlife and land managers may be afforded opportunities to restore human-altered landscapes such as mined lands for wildlife benefits such as suggested by Beth MacCallum (1999). Through restoration, landscapes altered by human development should be specifically designed to minimize adverse risks associated with global warming. Areas prioritized for wildlife recovery must include long-range planning objectives that account for potential habitat change and variability.

Finally, wildlife managers must consider the "carbon footprint" of their own activities by reducing reliance on fossil fuels. Plans are already being put in place to significantly reduce gasoline-powered vehicles by 2030, and complete transition to electric vehicles soon after. Wildlife managers should not only re-assess vehicle use but should also consider using battery-powered drones as an alternative to helicopters or other aircraft for wildlife surveys and increase use of remote sensing of radio-collared animals.

While there are significant challenges associated with a warming climate, there is hope. Temperatures observed over the past year are not yet averages but rather represent the far tail of extreme earth temperatures. If we adopt these measures and others beyond the scope of this audience (including ending reliance on fossil fuels in favor of solar, wind, and hydropower, ending deforestation, restoring forests where possible, increasing crop yields to reduce the need to expand land dedicated to agricultural production, and reducing the demand for meat in our diet) we may not only limit climatic warming to acceptable limits, but also create a truly sustainable planet for many future generations of humankind (Ritchie 2024).

The "take home message" is simple: Global warming is NOT someone else's problem. It is a universal problem; one we all have to address…and many of you in the audience today will find yourself on the front lines of creating solutions as you work to recover wildlife populations in a changing environment.

REFERENCES

Bar-On, Y. M. R. Phillips, and R. Milo. 2018. The biomass distribution on Earth. Proc. Nat. Acad. Sci. USA 115:6506–6511.

Bradshaw, C. J. A., Ehrlich, P. R., Beattie, A., Ceballos, G., Crist, E., Diamond, J., Dirzo, R., Erlich, A. H., Harte, J., Harte, M. E., Pyke, G., Raven, P. H., Ripple, W. J., Saltre, F., Turnbull, C., Wackernagel, M., and Blumstein, D. T. 2021. Understanding the challenges of avoiding a ghastly future. Front. Conserv. Sci. 1:615419.

Burke, E.J., S.E. Chadburn, C. Huntingford, and C.D. Jones. 2018. CO^2 loss by permafrost thawing implies additional emissions reductions to limit warming to 1.5 or 2^o C. Environ. Res. Lett. 13:024024.

MacCallum, B. 1999. Creating sheep habitat. Pp. 204-205 *in* Toweill, D. E., and V. Geist. 1999. Return of Royalty: Wild Sheep of North America. Boone and Crockett Club and Foundation for North American Wild Sheep. 214pp.

Paine, R.T. 1966, Food Web Complexity and Species Diversity. Am. Midl. Nat. 100(910):65-75.

Ritchie, H. 2024. Not the end of the world: How We Can Be the First Generation to Build a Sustainable Planet. Hachette Book Group, New York. 339pp.

Rogelj, J., M. den Elzen, N. Hohne, T. Fransen, H. Winkler. 2016. Paris Agreement climate proposals need a boost to keep warming well below 2 degrees C. Nature 534:631–639.

The Wildlife Society. 2004. Global Climate Change and Wildlife in North America. Tech. Rev. 04-2. 26pp.

Thomas, J.W., and D.E. Toweill. 1982. Elk of North America: Ecology and Management. The Wildlife Management Institute, Washington, DC. 698pp.

Toweill, D. E., and V. Geist. 1999. Return of Royalty: Wild Sheep of North America. Boone and Crockett Club and Foundation for North American Wild Sheep. 214pp.

United Nations. 2016. The Paris Agreement. United Nations Framework Convention of Climate.

Wilmers, C.C, C.R.L. Crabtree, D.W. Smith, K.M. Murphy, and W.M. Getz. 2003. Trophic facilitation by introduced top predators: gray wolf subsidies to scavengers in Yellowstone National Park. J. Animal Ecol.72(6):909–916.

Wilson, E.O. 2016. Half-Earth: Our Planet's Fight for Life. Liveright. 272pp.