KEYNOTE ADDRESS: When the Unexpected Happens

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ABSTRACT: Involvement in this symposium supposes an interest in wild sheep and goat management. Agreement on what 'management' is may be helpful. In the most general sense management may be thought of as '*Intervening in any established system to produce, maintain, or expand a pre-defined benefit*.' Wildlife management plans define interventions based on desired outcomes that assume reliable inputs. When unanticipated inputs produce unexpected outcomes, managers themselves, as well as those for whom they manage, are expected to "fix it." In practicality, there's only so much input to population size, welfare, and flux that managers can 'manage by intervening.' By analogy to the universal resistance to 'driving force,' except in cases of previous management mistakes that limit population input, it will be argued the singular manageable component affecting population throughput, and 'management success' is overall environmental resistance. Environmental resistance comes in two basic forms, biological or ecosystem effects, and human societal effects. In extreme circumstances, agencies may choose to intervene to minimize the effects of biological resistance. Examples include adjusting human harvest levels or predator control, to achieve management success prescribed by agency mandates. Agencies may also intervene through efforts to more closely maximize 'forcing pressure' by hoping to increase birth rate and survival of young. The human component of 'environmental resistance' to 'successful management' depends increasingly on public opinion, which may or may not be aligned with management mandates. The papers in this section will deal with both aspects of managing environmental resistance to achieve management success. Topics include biological components such as disease, movement, nutrition, population dynamics, and predation. Papers addressing human social resistance include human dimensions, policy, citizen science, and public opinion.

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When I was first introduced to wildlife management (*circa* 1966), the definition of 'wildlife management' was primarily intuitive. The vague definition of 'management' at the time aspired to 'smoothing the fluctuations' in managed populations to produce a sustained, steady expectation of opportunity and harvest for hunters.

At that time, 'biotic factors' were the dominant drivers of aspirational management plans designed in pursuit of that rather nebulous goal. Common management actions focused primarily on protecting habitats by keeping managed populations below nutritional carrying capacity.

Over the intervening years, management by trial and error plus ever-broadening management experience drove me toward a generalized definition of 'management. I suggest management amounts to, "*Intervening in any established system to produce, maintain, or expand a pre-defined benefit*." This generalized definition may be useful in framing our responses to contractions in northern wild sheep and goat populations. I suggest it is worth considering we have only two options for hastening recovery.

BACKGROUND

The REALLY BIG picture

At the Second Northern Wild Sheep Conference in 1972, I presented a predator/prey paper (Heimer in Thomas and Thomas 2000). This effort focused on wolf (*Canis lupus*) predation on the Fortymile Caribou (*Rangifer tarandus*) herd and critique of the "multiple equilibrium theory" of predation. Sheep were a corollary consideration.

The accepted context of multiple equilibrium theory was complex and mathematically elegant but had its basis in assumptions originally modeled on predation of spruce budworm larvae (*Choristoneura spp.)* on spruce buds. That theory had been applied to wolves and their prey, but in practicality, did not seem to match reality. The multiple equilibrium theory is still around, but less influential in Alaska than 25 years ago.

Looking for a better approach, not only to predator/prey dynamics, but to management in general, I began to look elsewhere in nature.

A simpler generalized model

As an alternative to this complex and failing theory, I proposed a much simpler model analogous to "Ohm's Law" of electric current flow. When expressed as an equation Ohm's Law is, I = V/R, where "I" represents, "amps" or current flow. (By analogy, managed 'population throughput' available for human uses).

"V" is "voltage," the 'forcing pressure' that causes current flow. By analogy forcing pressure is 'biotic or reproductive potential,' and represents the ideal capacity for maximum population input where there is no environmental resistance.

"R," of course, stands for the resistance to current flow. By analogy it represents the cumulative 'environmental resistance' to 'population throughput' that typically defines management success.

My suggestion was that managers set aside the comfortably sophisticated, but failing 'multiple equilibrium theory,' and address the cumulative manageable factors affecting management success by maximizing 'population throughput." Those factors were 'reproductive potential' (a theoretical, though perhaps unrealized constant) and cumulative 'environmental resistance.' In terms of what was manageable, I suggested 'environmental resistance' was where management efforts should be focused.

Author's Note: *It is rare when we find a way to increase 'forcing pressure' (analogous to voltage) in a wild population. When we do, it may require adjusting to an earlier, well-meant, but harmful, management practice. Stopping overharvest or preventing introduction of 'exotic diseases' are the best examples I can cite to date. I allege we once made an adjustment to harmful ram harvest regulations in Alaska. This management intervention came after data indicated a scarcity of mature rams was associated with lowered lamb production, but that's another story (see Heimer 2022).*

Of course, 'environmental resistance' encompasses everything that checks population growth. It includes predation by furred and feathered predators, harvests by human predators, and mortalities due to nutritional insufficiency caused by weather and perhaps population density effects. This final factor limits pregnancy rates and lowers lamb birth weights (Lohuis *et al.* 2023). Lower birth weights correlate with low lamb survival and lowered population recruitment. Disease, and other 'stressors' are also components of 'environmental resistance.' Managers may influence some of these mortality factors, but not others.

By extension, the argument becomes: *'Environmental resistance" (comprised of its various components) is collectively additive,* ***and lessening any component should result in increased population growth or more rapid recovery after a 'crash.'***

Put another way, the 'population throughput for benefit to users,' (which traditionally defines management success) is directly proportional to species 'biotic potential' (or driving force). In contrast, management success is inversely proportional to overall environmental resistance. Seen from a broader perspective, this relationship appears to be a unifying principle that works in a broad variety of physical applications as basic as plumbing. It also predicts well in abstract adventures such as expression of social mores where success is the quotient of effort divided by resistance.

The big picture

For me, greater awareness of pre-defined benefits and environmental resistance to successful management came with greater personal experience. Observation of events related to researching and managing wild sheep, particularly Dall sheep (*Ovis dalli dalli*) in Alaska, coupled with experience in management planning, attempting cooperative interagency management, societal shifts in bio-politics, and an immersive experience in Alaskan state/federal conflict, informed the resulting generalized definition of management (see RESULTS).

My personal story leading to epiphany

When I stumbled into wildlife management in 1971, I was hired as a Dall sheep research biologist with the Alaska Department of Fish and Game (ADF&G). In those, apparently desperate hiring days, there was only a vague notion of what 'wildlife management' was. However, it was assumed that knowing more about Dall sheep biology would somehow redound to better management. This is called 'the Roosevelt Doctrine' (Toweill and Geist 1999). Not knowing any better, I reasoned intuitively, that Dall sheep research was strategically planned to benefit Dall sheep management, even if nobody could quite define what management was. It should not have been that hard in Alaska. Here's why:

Alaska's specific statutory mandate was, (slightly paraphrased) '*to* manage [by my definition via intervention]*, to protect, maintain, improve, and extend the Dall sheep resource of Alaska in the interest of the economy and general well-being of the state.*' This was (and remains) the ADF&G Commissioner's job description, and I was one of the Commissioner's minions. Hence, it was my job description too…whether I (and the Commissioners I was 'minion to') recognized it or not.

That did not concern me much when I began as a 'boy biologist' because my assigned task was "research" not 'management.' Nevertheless, I soon intuited that 'management' seemed a rather aspirational activity intended to minimize, smooth, or 'damp' natural fluctuations in wildlife populations. Nichols (1976) articulated this before I stumbled into personal perception. It was commonly understood that the reason for smoothing population 'ups and downs' (particularly 'damping the downs') was so there would be a steady, sustainable yield for hunters at harvest time.

As it turned out, I was left to my own devices to define research projects I thought would benefit management. My first real assignment was to '*Wind up the Dall sheep projects on the Pittman-Robertson books because unfinished projects interfere with future funding.*' The sheep biologist before me, Jim Erickson, had been killed in a plane crash on a sheep survey. After finishing what Jim had started, I was supposed to think up some management-relevant research of my own.

Following intuition and trying to figure out what Jim Erickson must have been thinking, my partners and I stumbled toward management relevance in the ongoing research we inherited, and what we did to add to it. It wasn't until 20 years later, when I got involved with State and Federal management conflicts, that I began to read the Alaska Constitution and Statutes. That was when I began to learn what my real job (and that of the Commissioners for whom I worked, plus that of all my co-minions) had actually been all along. Luckily, my intuition about management relevance and the critique of fellow 'Commissioner's minions' (as well as colleagues such as yourselves) led to management changes that turned out reasonably well (greater realization of 'biotic potential') despite sometimes stinging criticism (Heimer 2012).

So what?

These changes, recorded in our proceedings over the years (summarized in Heimer 2022) may serve Alaska's Dall sheep management well during the anticipated period of lower Dall sheep abundance. Despite the seemingly catastrophic decline in sheep populations, overall hunting success last year declined from a long-term average of about 27% to 24%. As the resource declined, hunter participation also declined to the lowest on record while collective hunter success remained high.

I continue to argue that just because sheep populations are depressed, there is no reason for managers to be depressed or depress others. While population contractions were not a feature of management plans, they "happened' anyway, and we'll get through them when 'environmental resistance' naturally decreases, or we lessen it through management intervention.

Competing Management Mandates

Alaska's specific (also intuitive) mandate was (and remains) defined in Alaska's Constitutional Policy (Alaska Constitution Article VIII SECTION 1. 1959). In the more detailed Alaskan Statute implementing Constitutional policy, the functions of the Commissioner (the designated manager and his/her minions in the Alaska Department of Fish and Game) are to, ' …manage, protect, maintain, improve, and extend the…game…resources of the state in the interest of the economy and general well-being of the state." (Title 16. Sect.16.05.020 (2) Functions of the Commissioner. 1959).

These relevant Constitutional and Statutory mandates have remained unchanged for more than 60 years. Other managing agencies, States, and Provinces may have differing mandates (more on that later).

When I started in Dall sheep research in 1971, sheep management and research were fairly new to wildlife management, and not a high priority (Heimer, in Toweill and Geist 1999). Field assistants had not yet become commonplace. Out of necessity, I 'partnered' with the designated Regional Dall sheep manager, a dynamic fellow named Tony Smith. He helped me with research projects, and I assisted him in management. Together, we provided a biological rationale for and wrote the first Dall sheep management plans for the State of Alaska. When we were tasked with writing Dall sheep management plans, we had no hint that weather would become unstable, or populations

would crash as a result.

At that time (1974) we were aware that the accepted, template-driven, management objectives such as population size, recruitment rates, allowable harvests, and so forth were beyond our control. Consequently, we tailored Alaska's management objectives to the spectrum of sheep hunting experiences desired by hunters, the managed users of Dall sheep. Based on horn growth dynamics (finally published as Heimer and Smith 1975) and reported human-use levels by area, we matched the varied population capabilities and existing uses with the types of experiences hunters desired. These hunter desires had been defined by an extensive hunter survey from 1973 (results from 50 years ago were used internally by the managers and not published). Those plans were either so successful or forgettable that they remained basically unchanged for 50 years. That story is detailed in Heimer (2022).

Eventually my management partner changed careers to become an equine reproductive specialist, and I assumed the dual role of Dall sheep researcher/manager. From there I was (involuntarily) shunted from a specialty in Dall sheep to general species management of everything from furbearers in the Alaska Range to caribou on the Arctic Coast (that's about half of Alaska). Following that 'seasoning experience' I was assigned to work in resolving State/Federal management conflicts (Heimer 2022). Those challenges arose because of differing management mandates between alleged 'co-managers' with opposite pre-defined benefits.

RESULTS

The State of Alaska had a pre-defined Constitutional and Statutory benefit (maximum allowable harvest by hunters in the interest of economy and general well-being of the State). That mandate was opposite to the dominant ethos of the federal management agencies as interpreted from the Alaska National Interest Lands Conservation Act (ANILCA 1980).

The federal management mandate focused primarily on 'stewardship' of 'natural and healthy populations' on Federal Public Lands. In the parlance of the day, this meant the pre-defined federal management benefit was primarily interpreted as minimal human use under the rubric of restrictive 'subsistence use' by rural residents.

In the immediate aftermath of ANILCA, we ADF&G types argued that 'stewardship' amounted to 'non-management.' However, once I was somewhat removed from the day-to-day challenges of intervention focused on Alaska's maximal use mandate, I began to take a broader look at what 'management' was. Here, again, is my suggested definition:

Management is intervening in any established system to produce, maintain, or expand a pre-defined benefit.

DISCUSSION

Conflicting pre-defined benefits

In a dazzling epiphany, I discovered the federal managers were doing exactly what the State managers were doing. They were 'intervening;' just with an opposite mandate. Both were 'intervening' in the State's established, i.e. pre-existing, maximum-use ethic. Alaska's pre-defined benefit was to maintain maximum use for economic and general Alaskan well-being. The 'new' and contrasting, ANILCA-derived mandate was to provide minimal subsistence use for a restricted class of Alaskans defined as "rural residents." The assumption was that this management would be done cooperatively. That didn't work out well, and conflicts resulted.

The State-Federal conflicts exist because the management mandates are in maximal ideological conflict. The State mandate (and the existing, use-tailored system it generated) called for **maximum** use. The federal mandate called for **minimum** use. Those polar opposites (the latter-day dazzling epiphany) drove me to the proposed general definition of what management (in any system) is. It is "*Intervening in any established system to produce, maintain, or expand a pre-defined benefit.*"

When pre-defined benefits are as opposed as they are between State and Federal managers, there are bound to be conflicts. I have written paper after paper about those conflicts. Our past proceedings from the 1980s and 1990s are full of obsolete papers detailing these conflicts. (I shall not cite them because nobody cares any more). When one management partner is charged with providing maximum use and the other is charged with minimizing use, co-management becomes a fantasy.

Again, so what?

To date, there has been very little progress toward resolution of the differing mandates. Legal contests have gone as high as the US Supreme Court, where

Alaska's management responsibility has been found to trump the assertions of primacy in the specific case of managing navigable waters, and what swims through them (United States Supreme Court 2019). Other legal actions (like the ongoing suit over Kuskokwim salmon intervention-or not) are sure to follow. However, the federal land managers still assert their 'stewardship' responsibility for 'natural and healthy populations' (under the rubric of 'subsistence preference'). This precludes any management intervention in the natural ecosystem other than to minimize use/disturbance. Where management interventions that would benefit subsistence users on federal lands are proposed, they are rebuffed by interpretation of the 'natural and healthy' language in ANILCA.

But what about weather-depleted populations?

Returning to our original assertion that management will be most effective (by lowering as many additive components of 'environmental resistance' as possible) leads us to today's papers on the subject. Some of this session's papers will focus on the biotic components of 'environmental resistance.' These papers include consideration of disease, population movements, nutrition, population dynamics, and predation.

Other papers address the more human aspects of environmental resistance. These include human or socio-political opposition to interventions that may reduce biological environmental resistance. Those offerings will address human dimensions, policy, citizen science, and public opinion.

An afterthought

While 'reproductive potential' may be thought of as a constant (individual sheep can only reproduce so fast). "Forcing pressure" may be increased if the ultimate managers, Commissioners, Directors, Pittman-Robertson fund allocators, and Non-Governmental Organizations) acknowledge the pre-defined benefits to which they are responsible and pursue them aggressively. Based on my experience, if population recovery in the shortest possible time is a priority, the additive components of 'environmental resistance' will have to be lowered. That would amount to intervention to achieve a pre-defined benefit.

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