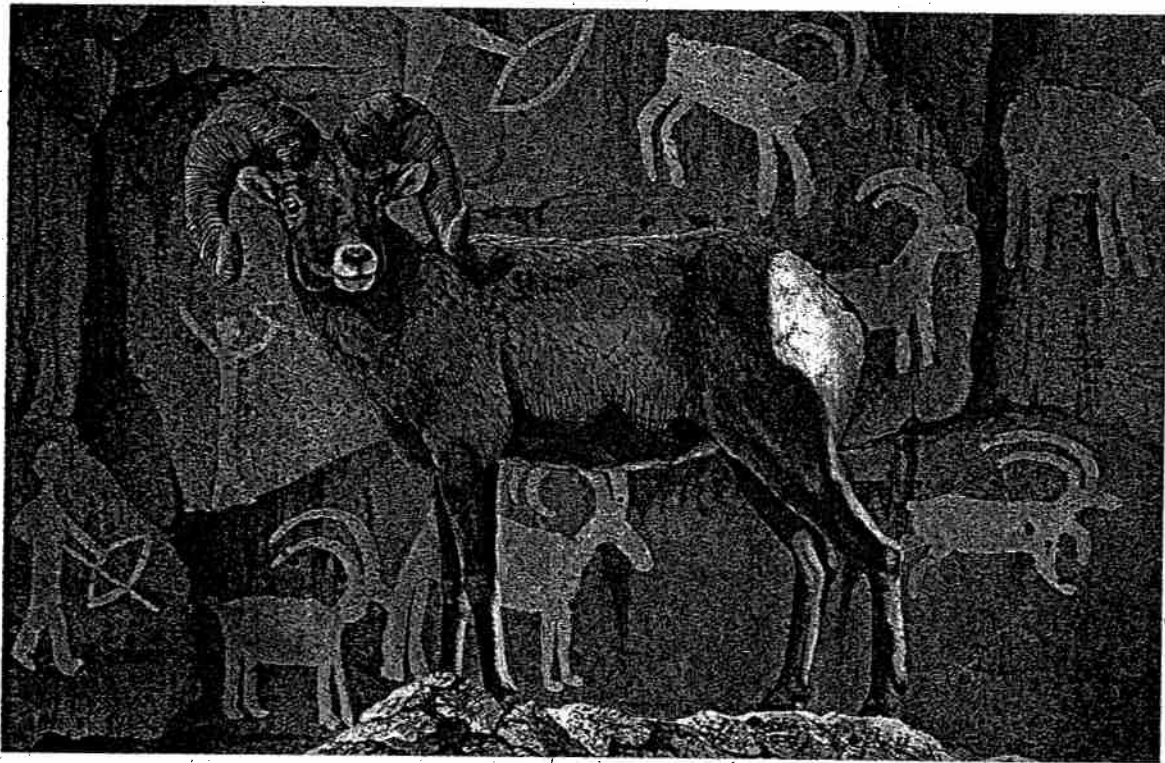


**STAFF  
ARTICLES**

# TRANSACTIONS

## 2ND NORTH AMERICAN WILD SHEEP CONFERENCE

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## WAYNE HEIMER - WOLF MANAGEMENT IN ALASKA'S INTACT ECOSYSTEMS: AN OBSERVER'S REVIEW, CRITIQUE, AND FUNCTIONAL PRESCRIPTION

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**Abstract:** Once early humans realized their survival was affected by competition with other predators, human mental capacity was applied to the competition. Consequently, technology advanced, man became dominant, and predator populations declined. As human and cultural evolution progressed they resulted in the eventual establishment of varying centralized governments in Alaska. Attitudes toward, technologies employed, and participation in predator management varied greatly with the governmental system. Under Federal Territorial administration, predators were considered pests, and subjected to wholesale extermination attempts by federal pest control agents. At statehood, federal power was limited, and the new State of Alaska raised the public status of predators to allow their management as integral parts of intact ecosystems. Because of their high fecundity, wolves soon recovered from the overuse of federal territorial days. Reduced human benefits from populations that were prey for both wolves and humans soon followed. This prompted the State to propose wolf population control to re-establish human benefits. Owing to development of sociopolitical resistance to wolf management, based on romantic interpretations of wolf biology, this enterprise became difficult. State managers went to extraordinary lengths to assure opponents that wolf management, including population control designed to increase human benefits, would not result in extirpation of wolves. When two modern control programs were finally completed, one was successful in restoring moose populations; the other failed. The fact that wolf control was not invariably and demonstrably linked to increased prey abundance was politically exploited by opponents of wolf management. Withdrawal of federal, Pittman-Robertson, funding from use in wolf population control (a federal decision) also interfered with state wolf management success. In an effort to cope with the sociopolitical environment, the Alaska Department of Fish and Game invested heavily in the planning process and adapting multiple equilibrium theory to mammalian predator/prey systems. This model of predator/prey interaction predicts that prey abundance requires only occasional wolf population control. Increased levels of human benefit have not been consistently sustained as predicted by this model. As a result of these seemingly divergent factors, State-sponsored wolf population control to produce human benefits has ceased in Alaska; and many prey populations are in decline or exist at low levels. Here, I suggest managers simplify their predation model, defining predation as an additive component of overall environmental resistance which must be lowered if prey populations are to increase. If a mathematical model is necessary, Ohm's law of electrical resistance expressed as  $I=V/R$ , should serve practically and with sufficient eloquence as both a conceptual and functional predation model. It empirically assures consistent regulation of predator populations, the most significant management-alterable component of environmental resistance, will result in increased prey population growth.

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I'm not a wolf biologist, and I'm not a predator-prey specialist. This being the case, perhaps I should suggest some reasons why you should take the time to read what I have to say about predator management in Alaska. For one thing, I paid close attention to what was happening with predator management during the turbulent quarter of a century I worked as a wildlife biologist at the Alaska

Department of Fish and Game (ADF&G). For most of this time, I shared an office with my friend, Bob Stephenson, as he was developing a world reputation that eventually landed him on the International Union for the Conservation of Nature wolf team. Because Bob was up to his ears in wolf biology and management during the most recent resurgence (and perhaps the swan song) of man-

aged wolf populations, I had an unusual opportunity for an "inside look" at the interface of biology with politics without being personally involved.

Wildlife management in general has a powerful political component, but wolf management in the last quarter of the 20th century may represent the zenith of political influence on biological wildlife management. Because of the time in which I served with the ADF&G, I had the unique opportunity to be present through periods characterized by open aerial wolf hunting and raising wolf status to the level where advocating wolf management became equated with political suicide. I was present when the last great wolf control programs were argued and begun. My colleague, Mel Buchholtz, pressed me into service to help take the first wolves of the "modern wolf control era." Being otherwise external to the process, I suggest I've maintained a sufficiently objective distance to evaluate the scope of changes in biological and administrative thinking and the introduction of theoretical modeling of predator/prey biology, which has become a discipline unto itself. In short, you might find what I have to say interesting because, I have been an "inside" but uninvolved observer. Borrowing from the late outdoor and firearms writer's autobiography, I can say with Elmer Keith (1979), "*Hell, I Was There!*"

**REVIEW: ANCIENT HISTORY:** I wasn't actually there from the beginning, but archeological and fossil records indicate that as long as man has been identifiable as a species, he has competed with wolves for prey. In the balance of physical adaptations, wolves are clearly better equipped to catch and kill prey than men are. Wolves can run longer and faster than men. Additionally, they are better adapted for killing, and stand cold exposure better than men. In truth, about all men have going for them is intellectual capacity.

We may hypothesize that early man didn't see wolves as competitors until his brain developed to the point of linking cause with effect. Prior to understanding wolves as a predator, it seems a safe assumption that man lived a precarious and wretched existence during the time when his

ability to compete with wolves for food was virtually nonexistent. However, once the brain developed to the point that man realized he was in competition with wolves, and put his mind to developing ways of competing more effectively, the balance changed radically. Development of biological understanding and technology allowed humans to aggressively escalate their competition with predators.

In Alaska these technical breakthroughs produced aboriginal "denning," the practice of killing wolf pups at dens to reduce populations, the evolution of trapping, primarily through snaring and dead-falls, and the clever invention of what we might call mechanical poisons. I judge the most ingenious of these to have been a small piece of whale baleen coiled inside a frozen piece of fat. Once ingested, the fat would be digested, the baleen fragment uncoiled, and the digestive system of the unfortunate wolf who had taken the bait lacerated, thus eliminating that wolf from the competition for prey items.

More effective human competition with wolves and other predators resulted from the interaction of aboriginal Alaskan cultures with immigrants from Russia and Western Europe. Perhaps the most important advance introduced by the more recent immigrants was metal. Early whalers and Russian trappers introduced firearms and steel traps as human adaptations in the competition with wolves. The developing technologies introduced by this wave of Alaskan immigrants eventually improved everyone's ability to get around the country as machines eventually supplanted travel by foot and dog sled. This second wave of immigrants eventually augmented the mechanical poisons developed by the earlier Asian/Siberian immigrants with metabolic poisons, and accelerated the use of firearms in the competition with wolves. Eventually, these technical innovations melded to the point that metabolic poisons were delivered by aircraft which were also used to deploy steel traps and wire snares, and as shooting platforms for killing wolves.

**RECENT HISTORY:** Of course political evolution

accompanied technological development of more effective competitive mechanisms for use against wolves and other predators. Alaska was "claimed" by Russia, and subsequently "sold" to the United States, becoming the Alaska Territory. Gold rushes and other human developments followed and the competition with wolves escalated. The competition between predators and men reached its most extreme expression at the end of Alaska's territorial period. At that time, there was "wholesale war" on predators under the auspices of the U.S. Biological Survey (which eventually became the U.S. Fish and Wildlife Service). Originally, this wolf suppression effort was implemented to protect domestic reindeer herds in Northwestern Alaska, but the practice of "pest control" spread to other parts of the state to increase human benefits from wildlife by limiting wolf predation (Rearden 1999).

In its fledgling days, the State of Alaska continued with wolf control programs for a time, but soon decided to "upgrade" wolves and other predators from the antique federal "pest and varmint" classification, recognizing them as important and integral components of what were envisioned as managed Alaskan ecosystems. Following closely upon the State of Alaska's raising the status of wolves and other predators, emerging wolf-protection advocates began a vigorous crusade to prevent harvest of wolves by humans. The national electronic and print media played major roles in this program. At the outset, victories for wolf-protectionists were relatively easy because there was minimal interest in wolf population control. The effectiveness of federal and early state wolf population control had lowered wolf populations in many areas of the state to the point that wolves were not an effective check on prey population growth. Ungulate prey was abundant.

Where wolf populations were considered "too high" by human users, privately subsidized wolf reduction efforts and public aerial hunting (see Heimer, working hypothesis paper this proceedings) suppressed wolf population recovery somewhat through the 1960s. After this period of non-governmental wolf suppression, aerial wolf shoot-

ing was banned because of public sentiment mobilized against the practice. This pressure was most effective because it came during the tenure of an Alaska Fish and Game Commissioner with a deep personal bias against aerial hunting. Once poisoning was banned and aerial shooting was disallowed, wolf populations rapidly recovered.

*CONTEMPORARY HISTORY:* Since man had effectively withdrawn from the historic competition with wolves because of altruistic ideology, it wasn't long until the competitive advantage shifted back to the better-adapted wolves. When this happened, prey-dependent human populations began to demand re-invigoration of the historic competition of humans with wolves. The proposed mechanism for this competition was allowing public aerial hunting once again. This pressure was basically ignored, coming as it did during the tenure of the above-mentioned Commissioner who was stridently against aerial hunting, especially by private individuals. Still, the clamor for more prey animals for humans continued. The resulting compromise, once a new Commissioner was appointed by a new Governor, was a proposal for the Alaska Department of Fish and Game to do predator control using aerial shooting as the major technique.

This initial proposal was vigorously opposed by wolf-protection interests, and animal rights activists who had joined the battle. Every subsequent wolf population control program has been vigorously opposed by this powerful axis. These interests found sympathetic supporters in national media outlets, primarily network newscasters looking for sensational news items. In one instance where I was present, Jack Perkins, then a field correspondent for the NBC Nightly News, lied to me about the use to which NBC News would put film of a wolf pack running through broken snow we had just taken from a helicopter. During our return to Fairbanks, I reminded Mr. Perkins that ADF&G had cooperated in helping him get the footage, and that we were all near death (because we were in a helicopter). After these grave reminders, I asked, "You aren't going to use this film to screw us, are you?" That's when Mr. Perkins lied.

He said, "No! We only report the news, we don't slant it!" However, in the end, Mr. Perkins filed a story in which the film footage we had taken was heavily edited to simulate an aerial wolf hunt which had not taken place. The NBC News editing included eliminating the helicopter rotor noise, dubbing in fixed wing airplane engine sounds, dubbing in a shotgun blast, and "freezing the frame" when the wolf being photographed stumbled in the broken snow. "*Hell, I Was There!*" (ibid).

Sensational "news" reports such as this on the national media generated tremendous revenue for those opposed to wolf management by population reduction. They also served to sensitize viewers and generate intense negative public reaction toward the State of Alaska from throughout the nation and world for such allegedly barbarous acts. The funds raised as a result of this outrage allowed wolf protection and animal rights interests to pursue their agenda in court.

Following this "raising of consciousness" by the national news media, the typical course of resistance to predator population management involved legal filings by those opposed to the process. In these early cases, opponents of wolf control would obtain a court injunction against the program pending hearings or trial. The universal result, once hearings and trials were held, arguments heard, and any administrative procedural mistakes rectified, was lifting of the restraining order and implementation of the program. In this environment, wolf population reduction was extremely difficult to implement. The early history of this era has been documented in detail by Harbo and Dean (1983).

In spite of these constraints, two major wolf reduction programs were undertaken. One, in the Tanana Flats south of Fairbanks, was highly successful in restoring moose and caribou abundance, and halting a Dall sheep population decline (Gasaway et al. 1983, Heimer and Stephenson 1982). The other, in the Nelchina Basin had little positive effect on the moose population there. Later work would show grizzly bears were heavily

involved in the moose population declines in the Nelchina Basin. Hence wolf removal didn't reverse the downward trend in moose numbers (Ballard et al. 1991). Three major changes in Alaskan wolf management history resulted from the legal strife associated with these modern wolf control programs.

*The first long-term effect* resulted from legal wrangling over the Nelchina Basin wolf control program. As a result of public pressure from outside of Alaska, the U.S. Fish and Wildlife Service arbitrarily precluded use of federal aid to wildlife restoration funding (Pittman-Robertson dollars) in wolf control programs by righteously, and simplistically stating words to the effect that 'We don't restore wildlife by killing it.' Withdrawal of federal funding did not directly impact the Nelchina Basin program because it was carried out using State of Alaska general funds while the federal aid dollars were diverted to other programs and projects deemed socially "acceptable" by federal aid administrators. In retrospect, the federal aid administrators appear highly inconsistent when they allow use of federal aid money for other habitat improvements for wildlife (which lower environmental resistance through the deaths of millions of plants and tiny animals in controlled or natural wildfire) but preclude the deaths of a few charismatic predators. The legality of this capricious choice by the U.S. Fish and Wildlife Service has never been questioned.

The importance of withdrawing P-R funding for wolf population management was that it meant only State of Alaska general funds could be used for wolf population control. This didn't seem particularly significant at the time, but would become a major factor eliminating man from competition with wolves for prey in the longer-term future. Unlike private aerial hunting or private wolf control programs, court-approved, state-sponsored predator population reduction requires large amounts of public money. When that money is limited to state funds, Alaska's Governor can effectively block any or all wolf control in the state by refusing to budget funds for it. As a result, it is no longer necessary for wolf preservation/animal

rights interests to defeat a more resilient public process which has money available (P-R dollars) to undertake unpopular programs in the interests of the human consumptive users who generate the funds. With federal aid money out of the picture, all that is necessary to stop wolf control is to convince one person, the Governor of Alaska, that wolf populations should not be managed. This is the present circumstance in Alaska. The present Governor doesn't like it, so it doesn't happen.

*[Author's note: As I write this final draft, a story of unprecedented micro-management is unfolding. The Governor is trying to force the Alaska Board of Game to pass regulations which would ban wolf trapping and hunting on half a million acres of state land to prevent the harvest of about one wolf per year from two well publicized wolf packs which have a territories near the northern border of Denali National Park. En masse resignations of State Fish and Game Advisory Committees are presently occurring as a result of the Governor's blatant attempt to control actions of the Board of Game. The end result is not yet apparent.]*

Second, management authority was effectively transferred from the Commissioner of Fish and Game to the Alaska Board of Game, i.e., from a professional wildlife manager to a board of politically appointed "laymen/women." The Alaska Constitution and the state laws which implement it vest management authority in the Commissioner of Fish and Game. The Commissioner has legal authority to hire folks to help him with this impossibly large task, hence the Department of Fish and Game. Under this system, the Commissioner had sole authority to implement or stop wolf control. However, when legal challenges to modern wolf control programs were being argued, wolf preservation interests asserted the issue involved allocation of wildlife harvests, which is the role of the Alaska Board of Game. Acknowledging the apparent "anti-wolf control" mood of the public, and some confusing language in the Board of Game's enabling legislation, the Department's attorneys conceded this point, thus effectively abdicating the Commissioner's management authority to the Board of Game. This meant the Commissioner

could not institute a wolf control program, even if done exclusively by Departmental biologists, unless harvest of the involved wolves had been "allocated" to the control effort. That is, the Board of Game had to approve wolf control plans and implementation programs before any recognizable wolf control program could be undertaken.

Through this uncontested "out of court" settlement by the Department's attorneys, the management authority of the Commissioner, who is Constitutionally directed to manage for production of wildlife for human food on the sustained yield basis, was subtly transferred to the Board of Game. This action re-enforced the relatively new, 'modern' notion that the public could not be involved in wolf control...only Departmental biologists. It also strengthened the hand of the Governor in predator management. Now, not only can the Governor appoint the Commissioner (who occasionally turned out to be an intractable wildlife professional who had to be "fired" if a meddling Governor demanded his obedience and couldn't get it), the Governor can also appoint members to the Alaska Board of Game. It was this Board which was given the authority over wolf control when the Department's lawyer conceded wolf control was an allocation issue.

The third longer-term result from the Nelchina Basin wolf control "failure" was introduction and establishment of scientific credibility for the now-politically correct notion that although predators kill prey, lowering predator populations has no predictable relationship to prey abundance. As stated above, the present Governor opposes wolf control to benefit human consumptive users. Many, perhaps most, rural Alaskans (which represent a traditional power base for the Governor's political party) differ with the Governor on this point. Hence, the Governor must justify his position if he (and his party) are to remain politically viable in rural Alaska. To meet this end, the Governor seized on the "failure" in the Nelchina Basin to assert the obvious fact that wolf control didn't produce an obvious increase in prey for humans when bears were the limiting predator. Almost 20 years later, on the advice wolf protectionists who

understood the workings of the National Academy of Sciences, the Governor contracted with the National Research Council (the review arm of the National Academy of Sciences) to evaluate the "scientific correctness" of the Alaska Department of Fish and Game analyses of the effectiveness of wolf control in producing human benefits. In spite of the fact that both the best (the Tanana Flats) and worst (the Nelchina Basin) of these experiences had already been documented in review articles published (primarily as monographs in the peer-reviewed *Journal of Wildlife Management*), the Governor and his advisors sought a "second opinion."

The National Research Council doesn't work for free, so to fund his review contract, the Governor used a third of a million dollars available to him through sales of Alaska hunting licenses and matching federal (Pittman-Robertson) funds. This review took more than two years, but the Governor got satisfactory results for his political agenda. An additional political benefit for the Governor was that, owing to the lengthy review period, he was able to replace some staunch wolf control advocates on the Alaska Board of Game (which now must approve or disapprove wolf control programs) with appointees he considered likely to share his opinion on matters of wolf management.

I consider it ironic that the very humans who wanted to compete with wolves for prey animals had paid (through their license fees and taxes on guns and ammunition) for the National Research Council to determine that not all wolf control programs will produce predictable and statistically significant positive prey population responses. This was, of course, not in dispute before the National Research Council review (because of the Nelchina Basin "failure"). Additionally, the review found that many Alaskans and others opposed wolf control, and that it did cost a lot of money. These findings have served the Governor's agenda well. He now has a prestigious report (National Research Council 1997) which allows him to delay any proposed wolf control program because it is expensive, and lacks broad public support (i.e., is opposed by urban Alaskans and out-of-state wolf

protection and animal rights interests). However, his most powerful reason to refuse wolf control is that it is "not based on sound science." In the end, the National Research Council review allows the "scientifically validated" conclusion that although wolves kill prey, they should not necessarily be considered a component of environmental resistance to prey population growth.

**CRITIQUE: FALLOUT FROM SOCIAL AND POLITICAL FACTORS RELATING TO WOLF CONTROL:** The "sound science" conundrum was compounded by the natural human tendency among upper level Department of Fish and Game administrators to minimize the distraction and discomfort associated with controversial predator management. The stress of what had become the "wolf management cycle" took its toll on the human resources of the Department of Fish and Game. Department leadership grew weary of responding to public demands for restored prey abundance by documenting prey shortage or downward trend, determining whether it was likely wolves were the primary cause of prey declines (with a level of confidence which could be defended in court), preparing subsequent wolf population reduction plans to increase prey abundance, taking these plans to the Board of Game, defending the plans, the Department, and themselves against constant vitriolic criticism (which always makes good "news" copy), being enjoined by the courts from proceeding, then going to hearings or trial, being vindicated by the court, and then either implementing the program or having it stopped or rendered ineffective by political constraints. Leadership began to express its feeling that other Departmental functions, not to mention staff morale and particularly not to mention their morale, were being negatively impacted by the constant, minimally productive wolf management efforts. Naturally, they began to look for relief.

The adaptive response of Department leadership was two-pronged. Leaders embraced public planning processes and multiple equilibrium theory in their search for relief.

**Public Planning Process:** The Department con-

tracted with consultants who had developed a highly successful program which enabled public agencies to succeed in implementing controversial public works projects. The program was called "Citizen's Participation," and attained success by effectively neutralizing project opposition. Neutralizing opposition was accomplished by getting opposing activists to participate in the planning phases of controversial projects. Along the way, the agency strategy centered on gaining the known opposition's incremental "informed, albeit grudging, consent" by neutralizing their effectiveness during the planning process. The thinking was that if opponents could be induced to "buy into" a project bit by bit, they couldn't credibly veto it at the end. The program had been highly successful in many controversial urban public works projects, and most Department personnel were sent to "Citizen's Participation" training. However, the Alaska Department of Fish and Game was insufficiently committed to implementing wolf control to use this apparently manipulative process to "sell wolf control" to the public by what many considered devious means "*Hell, I was there!*"(ibid).

Instead, Department leadership adapted two of the program's concepts, inviting all interested parties (especially opposition activists) to participate equally in the public planning process, and use of neutral, non-agency facilitators to run the planning meetings. Borrowing these two concepts, the Department pioneered its own course. "Affected interests," also called "stakeholders" were invited to sit down with wildlife biologists and planners to produce a statewide wolf plan.

This effort had the effect of involving the Alaskan public, for the first time, in developing management policy. Until this time, setting management policy had been the exclusive province of Department of Fish and Game leadership. The policy which emerged, with what was hailed as success, from this process, prescribed differing levels of wolf management (i.e., levels of human/wolf competition) based on land ownership and human demand for prey on those lands. For example, wolf management would simply not be an option within Alaska's vast National Parks (where harvest

by humans was generally precluded). On other federal lands which supported significant historic harvest by humans, a moderate level of wolf population management was to be a potential option, and on state-owned lands, which had been historically important sources of prey for humans, it was agreed that humans could enter heartily into the ancestral competition with wolves without organized opposition from those interests involved in the planning process.

This plan took about two years to develop as incremental informed consent emerged from confrontation. Still, some interests which had grudgingly consented to the plan didn't like it at all. Apparently, they had been 'lurking in the shadows' awaiting an opportunity to destroy the process. Eventually these interests, through unlikely but orchestrated deceptive 'support' for the plans of arch wolf-control advocates, succeeded in blowing up the process at the last minute before implementation. Here's how it happened.

With the plan basically finished, and requiring only final formal approval by the planning team, opponents of any wolf control, some of which had been appointed to the Alaska Board of Game, orchestrated the demise of the plan (S. Castle, member, Alaska Board of Game pers. commun.). Realizing "hard liners" in the Departmental leadership were anxious to implement the plan on state lands scheduled for maximum competition between humans and wolves, the "anti" influences on the Alaska Board of Game supported approval of Departmental wolf-control plans which basically "ran ahead of" the planning process (remember the plan had not yet received formal approval by the planning team). When wolf control regulations "outran" final formal approval, wolf protection interests "bailed out" of the planning team, righteously asserting that the Department had not operated in good faith.

In the resulting controversy, the Director of Wildlife Conservation unintentionally involved the Alaska Division of Tourism. In justifying the need for predator reductions to benefit the Fortymile caribou herd (which will be important later), the



Director argued that tourists, as well as hunters, benefit from wolf control because they like to see large numbers of animals. In making this argument, the Director colorfully referred to "Mom and Pop from Syracuse," and suggested that, with wolf control in the Fortymile, Alaska could become, "the Serengeti of the North." The good news was that these colorful statements expressed the potential viewing opportunity in appealing language. The bad news was that the Director had not discussed wildlife viewing by tourists as a justification for wolf control with the state's Alaska Division of Tourism. As everyone soon learned, the Division of Tourism is extremely territorial and assiduously dedicated to husbanding the "appropriate marketing" image for maximizing the state's economic benefit from tourism. These standards, based on the perception of "untouched wilderness" conflict with the concepts of managed ecosystems. The results have been that the Division of Tourism dictates how wildlife for viewing is to be provided. The Division of Tourism was highly offended by the Director of Wildlife Conservation, and made it clear that wolf control to provide animals for viewing was not considered appropriate from its agency point of view.

In an effort to salvage the progress which had been made (and the work which had been expended) the Department agreed to organize (with protectionist and animal rights advocates) a "wolf summit," where all viewpoints would be presented in a public forum. At this conference, protectionists mobilized the ecotourism segment of the generally offended Tourist lobby. Ecotourism business were clearly terrified by the specter of a tourism boycott threatened by wolf protectionists if any wolf control took place in the state. The then-Governor of Alaska, had made his fortune in the hotel/tourism business, and was particularly susceptible to the influence of the tourism lobby. In the resulting compromise, the ecotourism/wolf protectionist axis got the Governor's administrative ban on aerial wolf control to prevent the threatened tourism boycott, and those humans demanding competition with wolves for food got a wolf control program. The "catch" was that the program could not involve aerial shooting (the

bottom line for avoiding the threatened tourism boycott). Details of this adventure in planning have been reported elsewhere (Stephenson et al. 1995).

*[Author's note: This success in using "tourism" to derail wolf control programs has been effectively exploited by wolf protectionists ever since. In March 2,000, testimony to the Alaska Board of Game, tourism was frequently cited as justification for creating a half-million acre buffer zone around Denali National Park on the premise loss of 14 "park" wolves over 17 years to trapping outside the park would harm the tourism industry. Interests advocating for a "broader view" of wildlife management (read wolf protection interests) now frequently cite the value of tourist viewing of wolves as a justification to prohibit wolf management involving control of population size (Køeler 2000).]*

Prior to this ground-based wolf control program, it was generally held that a wolf population could not be effectively reduced if methods were limited to conventional trapping techniques. Nevertheless, the Alaska Department of Fish and Game set out to do exactly that to benefit depressed caribou populations and the humans who hunted them immediately south of Fairbanks. Trapping was unconventional in that it was done by locating wolf-killed prey animals from the air, landing on them with helicopters, and setting snares for wolves around the kill sites. The harvest of wolves by this trapping effort was surprisingly effective the first year, although the catch was primarily young wolves, which were more readily trapped than adults.

Still, all was not well. The Fund for Animals, a wolf protectionist group, had retained a sympathetic biologist to demonstrate the ugliness and inhumane nature of this trapping program. This biologist proclaimed himself the Department's "watchdog." Meaning no disrespect, I shall refer to him as such. The "watchdog's" flight budget was sufficiently large that he could fly the area almost as extensively as the Fish and Game biologists doing the trapping. Additionally, he had obtained (through earlier court action) the frequencies of

radio-collared wolves (many packs in the area were radio-collared) and located them often. Hence, it seemed only a matter of time until he found a live wolf in a trap. Still, the fact that the "watchdog" had been trying to catch the Department for years, and that Department biologists knew the "watchdog" was flying with a pilot who lacked expertise in aerial wolf tracking (pilots with well-developed tracking expertise initially refused to fly the "watchdog") led to a false sense of security and perhaps arrogance on the part of the Department. It made no plans for when it would eventually be caught on 'candid camera.'

The "watchdog's" relationship with his inexperienced wolf tracker-pilot eventually failed, and he finally found an experienced wolf-tracking pilot willing to take his money. Consequently, he became more effective at finding kills and wolves. The "watchdog" continued to wait for the Department to make a mistake. Eventually, it did.

The Department's biologist/trapper decided to "set" a conspicuous moose carcass in the the "watchdog's" area of special interest. More experienced field biologists recommended against "setting" that particular moose carcass, noting the "watchdog" was certain to find it. Their recommendations were overridden by the biologist/trapper's supervisor, who agreed with the biologist/trapper that they shouldn't "let 'the watchdog' tell the department where to trap." As predicted by the more experienced field personnel, the "watchdog" found the set with a live wolf in a snare.

Rather than dispatching the wolf, or contacting the Department to end its suffering, the "watchdog" kept knowledge of the live wolf in a trap to himself, returned to Fairbanks, contacted an Anchorage television station, and made plans to join a videotape crew and reporters who would helicopter up from Anchorage to record the suffering of the trapped wolf the next day. When the "watchdog" and his crew arrived at the trap site the next day, more wolves had been caught. While the crew was taping the "watchdog's" narration about the inhumanity of trapping and wolf control to benefit hunters, the Department's biologist/trapper arrived

by helicopter. His first concern was apparently for the trapped wolf. Hastily trying to humanely dispatch the most critical trapped wolf, the biologist/trapper allowed himself to be taped in a grisly, inefficient attempt to put the wolf "out of its misery." Later investigation would reveal he had hastily chosen the wrong ammunition for the gun he was using. This choice along with cold weather resulted in a low-powered load inadequate to kill the wolf, which he shot repeatedly at close range with non-lethal effects. The next day, the incident was nationally televised. The resultant public outrage was predictable, but involvement of Alaska's almost-new, and now-present, Governor was not.

At this time, Alaska was waiting on final counting of rural and absentee ballots in a gubernatorial election. The front runner (by only a few votes), who had allegedly never purchased a hunting, trapping, or fishing license in Alaska, immediately released a statement to the media detailing his disgust with and personal revulsion at the incompetence of the Department of Fish and Game over the incident. He stated that if he were the election winner, the program would be stopped, and fully investigated. He was, and so was it.

The new Governor turned investigation of the incident and audit of the biological program over to his newly appointed Commissioner of Public Safety and the Alaska State Troopers. The forensic evidence clearly indicated the biologist/trapper had selected the wrong ammunition (shooting a .22LR in a .22 Magnum revolver), and that in the -30°F temperature the load developed insufficient energy to dispatch the poor suffering wolf. This was found to be an error in judgment by the biologist/trapper.

With respect to audit of the trapping program, the first report released by the Governor's office stated the trapping program had been grossly mismanaged as well. This finding was inconsistent with the actual data regarding the program audit by the Alaska State Troopers. Subsequent investigative reporting by local newspapers revealed that the Troopers' report on the audit had been "heavily

edited" to put the program in a factually incorrect light. After the original "ghost copy" of the report was retrieved from the Troopers' computer, the "mistake" was rectified, and the audit finding was that the program (save the mistake in ammunition selection by the biologist/trapper) had been well-managed, and was completely within the guidelines established by the Board of Game and administrative process. Nevertheless, the program was terminated. Although the Governor's Chief of Staff apologized telephonically to a group of Department of Fish and Game employees threatening a grievance over the Governor's blanket insults of their work and ethics, the Governor has never been fully called to account on this matter.

Termination of this program and the questions about the Governor's political interference with day-to-day management of fish and game inflamed those to whom competition with wolves for caribou to eat remained an important issue. They persisted in petitioning the Alaska Board of Game to allow human competition with wolves for caribou. It was perhaps to get these folks "off his back" that the new Governor contracted with the National Academy of Sciences (National Research Council) as discussed earlier.

There is *one more "planning story"* associated with the contemporary history of wolf population control in Alaska. As just mentioned, humans committed to competing with wolves for food were not happy with the Governor's intrusive micromanagement-by-arbitrary-exclusion-of-humans from the competition with predators. Among the most distressed were lower-level biologists committed to traditional wildlife management as called for in the Alaska Constitution. As a rule, these ADF&G employees tend to be less "politically mature" than the ADF&G leadership. Consequently, they are more likely to take action. This planning story appears to be one such example.

In an effort find some way to establish wolf control to benefit the Fortymile caribou herd and its users, someone, allegedly the local area biologist, convened a planning team of would-be Canadian

users of the Fortymile caribou herd and a local advisory group from the Tok, Alaska, area. The apparent thinking was that this international "grass roots" effort would produce some positive results for the Fortymile caribou herd, a traditionally important food source for those involved. This once-huge herd had dwindled to where it was producing vanishingly small human benefits compared with the recent past. The localized, independent planning effort functioned briefly at the "grass roots level," but was soon co-opted by the more politically mature planning specialists in the Department's Fairbanks regional office. Following the procedure established in its statewide wolf policy near-miss, the Department's regional planners expanded the local group by inviting all "potentially affected interests" to participate.

Here, there is some disagreement in the story. The trappers claim they were not invited. The planners say they were. Whatever the cause, trappers were not formally represented on the planning team. Other "potentially affected interests" included representatives of regional fish and game advisory committees, Canadian Native hunters, anti-hunters, animal welfare advocates, environmentalists, and representatives from the Alaska Division of Tourism and the Department of Fish and Game. An external facilitator was hired as well. The major difference between this group and the earlier statewide wolf policy group was that management for a particular herd was the issue rather than policy development.

The planning team worked long and hard, apparently thinking they were actually planning to restore the Fortymile caribou herd. However, based on observations of the process over time and the eventual outcome, I suggest the group's original focus, restoration of the Fortymile caribou herd to provide human benefits, soon became secondary to each represented special interest's larger agenda. It wasn't long before each involved special interest appeared to be using the planning team to establish some advantage for its position, which might be exploited once the issue of wolf management policy (as had been the statewide planning focus)

was revisited. For any interest or organization desiring to control the future of wolf management, this was simply adaptive behavior. Whatever might come of a small, specific population management plan is secondary. Control results from influence on policy.

The result was a planning team which eventually reached a consensus where "everyone got something." The final plan had two phases. "Phase One" called for reductions in biologically insignificant human harvest (demanded by animal protectionists and would-be Canadian hunters), and encouraging trappers to reduce the number of wolves by conventional trapping practices. "Phase Two," scheduled for implementation if conventional trapping ever reduced the resident wolf populations sufficiently, called for Alaska Department of Fish and Game biologists to capture, neuter, and mark the alpha pair of wolves in each pack to see if the neutered wolves would hold their territories and keep fertile wolves from repopulating the area. "Phase Two" also called for Fish and Game to capture fertile subordinate wolves and transplant them to other areas.

When viewed in the cold (and perhaps cynical) light of practicality, the Fortymile plan appears less a caribou herd management plan than a "smorgasbord of gotcha's" for competing ideologies. Hunting interests swapped constitutionally mandated maximum sustainable human benefits for an on-the-record (and they thought precedent setting) admission by anti-hunters that wolf predation was the main factor limiting Fortymile caribou herd growth. Wolf protectionists negotiated away total protection of wolves to establish (what they saw as precedent-setting) acceptance of "non-lethal" wolf control by wildlife managers.

A look at the economics of trapping suggests neither side could have realistically anticipated it would ever really be faced with a decision on implementing "Phase Two" of the plan. After all, "Phase Two," sterilization of alpha wolves and translocation of fertile subordinates (euphemistically designated as non-lethal wolf control), was not to be undertaken until traditional trapping had

lowered the wolf population enough that sterilization of dominant pairs and deportation of their fertile subordinates became logistically and economically feasible for the Department of Fish and Game's research biologists. Viewed from outside of the planning team, this seemed a remote prospect for two reasons.

First, it was considered (in spite of the Department's early success in lowering the Tanana Flats wolf population using lavishly funded, helicopter-supported trapping prior to the TV scandal) axiomatic that trapping of wolves by traditional methods wouldn't reduce wolf numbers to the point the sterilization experiment would be feasible. Second, wolf pelt prices were so low that wolf trapping was certain to be a money-losing venture for any conventional trapper. In spite of these apparent obstacles to plan implementation, the planning team appeared positive about its compromise solution.

As mentioned earlier, everyone got something they wanted to influence future policy (on-the-record admission of the validity of its arguments from its opponents), and nobody had to give up anything critical to survival of their specific interest. Even the Canadians were happy because Alaska hunters had cut their harvest (a biologically insignificant quota) from 450 to 150 bulls in a symbolic gesture of international cooperation. The role of Canadians in this issue should not be overlooked.

In times past, the Fortymile caribou herd (numbering about half a million animals) migrated from Alaskan calving and summer ranges (located between Fairbanks and the U.S./Canada border north to the Yukon River) to winter ranges in the Yukon Territory. When these migrations took place almost 60 years ago, the herd was almost 20 times larger than when the plan was finalized. It has not followed the international migration pattern for decades. Nevertheless, the Canadians wish it would, and the planning team clearly *assumes* it will once again, if it gets large enough (the population goal is half a million caribou). In the spirit of consensus, Canadian Native "First Nations" exchanged their promise of compliance with the

plan's restrictive harvest provisions for the team's formal apology to "our mother the earth" for past mismanagement of the caribou herd.

The expected period of relative inactivity in implementing the plan (because "Phase One" would be long-in-coming, if ever achievable) was short-lived because the only affected interest group which had not participated in the planning process, the trappers (whose semantically disputable assertion is they were not asked), took action. Reminiscent of the days of lively competition between wolves and man, the Alaska Trappers Association arranged, through funding by private citizens and hunting interests, a competition incentive for trapping wolves. In what was called the "Fortymile Caribou Calf Protection Program" these "Competes-With-Wolves" Alaskans provided, through a local Fairbanks fur-buyer, for a supplemental price subsidy of an additional \$200 for the pelt of any wolf legally taken in the Fortymile caribou herd's range. Although Dall sheep were only marginally present in the Fortymile Caribou herd's range, this economic incentive program was largely funded by grants from the Foundation for North American Wild Sheep. The Foundation reasoned that if wolf populations could be controlled through conventional trapping, the program might be moved to where greater sheep benefits would follow.

The economic incentive brought the trapper's yield per wolf pelt to \$400, and changed trapping wolves in the Fortymile from a certain-loss to a profit-making enterprise for skillful trappers. The result was intense trapping pressure in the area. Within two years, the wolf population had been reduced to the point that the Department of Fish and Game had to face implementing "Phase Two" of the Fortymile Caribou Herd Recovery Plan. Implementing "Phase Two" was controversial. Nobody but the planning team and the Department of Fish and Game liked the idea, and many considered it unnecessary for herd recovery.

Coincident with the removal of wolves by trappers, the Fortymile caribou herd began to increase noticeably. By the time the Department was faced with the decision to begin "Phase Two," the

population increase rates specified in the Fortymile Caribou Herd Recovery Plan had already been obtained. The "Competes-With-Wolves" folks were ecstatic, but ADF&G officials appeared uncertain of their course. After all, admission that wolf control by trapping (particularly using a system which looked suspiciously like a "bounty" on wolves) could lead to demands for application of this approach to other areas where wolves appeared to be getting the best of men (who had been forced, by regulation to abandon effective competition with wolves for food) and the humans weren't liking the results. As a result, the Department produced official biological rationalizations that suggested, at their most inclusive extent, that trapping *might* have augmented caribou population growth, which resulted primarily from good weather and good luck. The Department's most credible assertion was that the subsidized harvest of wolves had not been focused in the core calving area.

From the trapper's perspective, these *post hoc* rationalizations were sufficiently assailable, and the Department's perceived zest for experimenting with wolf sterilization sufficiently apparent, that relations between the trappers and the Department were strained to the breaking point. This situation aggravated an existing tension between the trappers and the Department generated by the Department's blatantly negative reaction to the trappers' announcement of their plan "to help" accelerate herd recovery by lowering wolf populations numbers. I suspect the Department's negative reactions resulted from legitimate nervousness concerning longer-term anti-trapping sentiments coupled with institutional 'unease' associated with resurrecting the "bounty concept" where wolf management was concerned. Remember, Departmental leadership embraced the citizen's planning group concept to limit controversy. Hence, being "immediately" faced with implementing "Phase Two" appeared to be an unwelcome and unexpected opportunity.

The situation worsened because the trappers, having been rebuffed by the Department for doing what they considered the "right thing," also stood

to lose income if "Phase Two" were implemented. It seemed certain that if the Department were to experiment with "non-lethal" wolf control by sterilization and transplant of wolves from the area, the opportunity to make money through subsidized wolf trapping would vanish. Trappers argued in vain that they had been responsible for the increase in caribou herd growth, that they could assure future herd growth through trapping if it remained economically viable for them, and that the Department shouldn't "mess with Mother Nature" by sterilizing wolves. In this last argument, the trappers were aligned with their long-term arch-foes, the wolf protectionists. Neither thought sterilizing wolves was the thing to do.

When the Department, after months of withholding its plans, finally revealed it would undertake "Phase Two" on November 18, 1997, the Commissioner, Department leadership, and the planning team held a joint press conference. In the glow of the moment, the Commissioner announced that the Fortymile Caribou Planning Team would now become the Fortymile Caribou Management Team. The trappers withdrew their efforts from the Fortymile area.

*[Author's note: The Commissioner's promotion of the Fortymile Caribou Planning Team to the Fortymile Management Team appears to have foreshadowed the Governor's plans to further distance wildlife management from the Department and Alaska Board of Game. If the Governor is able to coerce the Board into protecting the two wolf packs on the northern border of Denali National Park, he has said he will appoint "adaptive management groups" [teams?] to oversee management of predators and prey in other critical areas. These groups would have the effect of further removing management from professionals (the Department) and paraprofessionals (the Alaska Board of Game), by placing management more directly in the hands of those sympathetic to the Governor's agenda. The Governor would play the pivotal role in appointing the members of these "adaptive management teams." WH]*

"Phase Two" has now been operative for almost

three years. Numbers of wolves, approaching 100, have been transplanted to compete with other wolves and other humans for food in other areas around Alaska. The caribou herd has continued to grow, and sterilized wolves have apparently held their territories. However, immigration of other wolves into the area has been high. It is uncertain whether or not the Department's deportation program has kept up with immigration. Controversy over the program has not abated.

Recall if you will, our friend, the "watchdog," from the TV videotape scandal in the Tanana Flats. The "watchdog" also monitored the non-lethal program in the Fortymile. This time, his techniques included flying high above the Department's biologists and contract pilots as they trapped, sterilized, and deported wolves. The "watchdog" also recorded conversations among these persons. In spring of 1999, the "watchdog" released these recordings for public airplay in Alaska. The tapes appeared to document that the Department and its contract pilots were engaged in unethical behavior, were negligent of the welfare of captured wolves, and guilty of technical violations of administrative rules established for the program. While there was a brief flurry of interest, no ethics complaints or charges have been filed by the "watchdog," and the entire incident appears to have dropped from public consciousness. It may be that the "watchdog" had "cried wolf" so many times in the past, his credibility, even with apparently irrefutable evidence, was sufficiently low that he could no longer be effective in his task. Alternatively, the "watchdog" may have longer-term strategies up his sleeve. The future may not be satisfactory, but at least it will be interesting with respect to planning and science.

**Multiple Equilibrium Theory:** Interesting science relating to competition of humans with predators for food has not been limited to the sociobiology of Departmental wolf control. Please recall my earlier hypothesis, that the stresses of the "wolf control management cycle" (public demand, department planning, Board approval, litigation, legal vindication, and administrative override) drove Alaska Department of Fish and Game

leaders to pursue two adaptive courses. The first was large-scale planning program and its eventual fallout just discussed. The other was apparent commitment to a multiple equilibrium theory of predator/prey population dynamics.

Multiple equilibrium theory is a conceptually simple but mathematically elegant model originally derived to study the dynamics of forests where insects prey on spruce tree buds. Conceptually, it predicts that when predator numbers (insect larvae in the seminal work) are high relative to prey numbers (originally spruce buds), predation will have a greater influence on the productivity of the forest than when there are relatively fewer insect predators. This much seems intuitively obvious.

However, interactions of the basic assumptions (from catastrophe theory) and the elegant mathematics describing the dynamic changes in predator and prey populations as the ratios of predators to prey change predict two "stable" or "equilibrium states." One is predicted at relatively high predator densities relative to prey. The other at relatively lower predator densities with respect to prey population sizes. By inference, at the "low-density equilibrium" prey populations subject to high predation can never grow sufficiently to overcome the environmental resistance due to predation. In this case, predators are capable, because of their relative high density, of killing all the young produced.

This model was particularly attractive to Department biologists and leaders for several reasons. *First*, it was conceptually simple and made intuitive sense.

*Second*, the multiple equilibrium model appears robust, particularly for "macro" systems. It has predicted well in forest and reservoir management situations (R. Demarchi pers. commun. this conference, and J. Bailey--see discussion at end of paper).

*Third*, the "low-density equilibrium" lent itself to an attractively alliterative appellation affected by

its biological aficionados, the term "predator pit." "Predator pit," conveyed almost everything wolf-control advocates needed to implant in the mind of a public which didn't seem to appreciate the need for predator reduction if man were to have access to prey animals. It subtly communicated, in almost Madison Avenue fashion, the desperate plight of prey populations under the unrelenting suppression of predators. Use of the term (which is also fun to say) readily explained why, without any actual elucidation necessary, it was important to curtail human harvests when predators had the upper hand in competition with man. It clearly conveyed the notion, "Things are serious!"

*Fourth*, it seemed intuitively apparent that if predators and prey are in balance at "high-density equilibrium," there should be enough prey that wolves wouldn't be in serious competition with humans. Surely, it seemed, man could harvest prey animals without having a measurable effect if there were lots of them. Further application of this casual intuition, apart from the complex semantic limitations of the term, *equilibrium*, and the mathematical constructs of the theory, were interpreted as showing that *wolf control is necessary only occasionally*, to "release prey animals from the predator pit." That is, intuitive reaction to the apparent notions derived from multiple equilibrium theory, without getting involved in its basic assumptions and bothersome mathematical details, seems to suggest that wolf control need not be an ongoing effort, but practiced only in periodic emergency situations where prey have been driven into the predator pit.

The prospect that wolf control would be required only occasionally (and not on a sustained basis) was bound to be highly attractive to Department leaders interested in escaping from the pressures of the "wolf control management cycle" detailed earlier. This being the case, it is not surprising that the Departmental leadership embraced the theory with apparent wholeheartedness. Had they been aware that our old friend, the "watchdog," was among the first proponents of applying this theory to predator prey systems in Alaska (G. Haber pers. commun., Walters et al. 1981), they might have

been a bit more cautious.

Experience with wolf reduction programs throughout Alaska over the last 25 years has shown simplistic application of multiple equilibrium theory just doesn't work in practice. Of the various applications of radical wolf reduction throughout Alaska (National Research Council 1997), only those areas with significant and consistent trapping or wolf hunting pressure (the Tanana and Minto flats) seem to fit the model for any extended length of time. Please remember this fact because I shall bring it up again in suggesting a functional prescription.

The primary reason application of an overly simplistic conceptualization of multiple equilibrium theory doesn't predict accurately for wolves, men, and prey in Alaska is that the semantic and mathematical constraints of the theory have been ignored. Analysis of the semantic difficulties, primarily misunderstanding the equilibrium concept (best illustrated in chemical terms), will serve to illustrate this problem. I can't do the complex math, so I shall be forced to deal with the semantics inferred from the, perhaps inappropriate term, equilibrium.

If the balance between predators and prey at low density were a true equilibrium, there could be, by definition, no change in either predator or prey population sizes. Only a decrease in predation rate, occasioned by a relative decrease in predator population size or predator efficiency, could disturb the equilibrium and allow the prey population to increase. Alternately, if predators take more than the annual productivity of the prey population at low-density equilibrium, the equilibrium will be disturbed, and the trend will result in eventual prey extirpation. Subtraction of any prey animals from a system at equilibrium, all else (particularly predator efficiency) remaining constant, will lead to nothing but predators remaining alive in the pit...until they eat each other and starve.

Likewise, by definition of the term equilibrium, the population sizes of predators and prey, prey productivity, and predation rate at high-density

equilibrium cannot change any more than allowable at low-density equilibrium. High-density equilibrium remains conceptually the same as low-density equilibrium, there are just more predators eating more prey. If high-density equilibrium truly exists, and man is unwilling to compete with predators for prey animals, no human harvest is allowable because any additional mortality will (by definition of the term, equilibrium) be additive and result in decreased prey abundance as prey populations are forced back into the pit.

*[Author's note: The National Research Council (1997 p84) discussed application of this model to pulsed wolf control. That report stated, in the context of applying multiple equilibrium theory to predator/prey management, that "In this context, equilibrium does not mean constant predator and prey densities, but that densities tend to return to the vicinity of the equilibrium if they are caused to deviate substantially from it." This prediction appears to stem from the basic assumptions driving the model. I consider this lack of accountability to the definition of equilibrium, indicative of a semantic mushiness which approaches my mathematical ineptitude. Imprecise language is of minimal utility in dealing with the semantic misunderstanding of equilibrium which drove Departmental leaders to embrace the concept as the model for predator/prey relationships. Furthermore, imprecise or altered language leads to sustaining rather than solving problems. If we can't communicate, we have no hope. WHJ]*

If one accepts a semantically rigorous definition of equilibrium, it follows that the management possibilities for increasing human use of prey arise only when equilibria (be they low-density or high-density) have been disturbed by lessening the overall effectiveness of predation.

This can be done by increasing prey production (while limiting wolf population growth) or by decreasing predation (by decreasing predator population sizes). Only when prey population increases are allowable because of decreased environmental resistance is a sustainable harvestable surplus for human uses even a theoretical



possibility. The assumption that there will be enough prey for "everyone" at high-density equilibrium is a mistake based on faulty semantics applied to the equilibrium concept. At "high-density equilibrium," there may appear to be no additive effect of harvest by humans (or predators), but that perception most likely results from the lack of sufficient resolution in population monitoring complicated by limited understanding of the equilibrium state. In plain words, we can't count predator and prey animals with sufficient accuracy that the data will force us to re-examine the accepted, muddled thinking about sustainability of harvest by humans where wolves and prey may exist at "high-density equilibrium."

**FUNCTIONAL PRESCRIPTION:** In this review, I have concluded the Alaska Department of Fish and Game bought into a flawed understanding of multiple equilibrium theory. My conclusion is based on two things. The first is Departmental preoccupation with "predator pit" semantics compounded by the logic of language as discussed above. The second is the frequent Departmental assertion that wolf-control is a temporary necessity or emergency measure employed simply to liberate prey from the "predator pit" and shift dynamics to the high-density equilibrium. This deceptively simplistic language suggests the high-density equilibrium state is a sort of golden pathway to "peaceful consumptive coexistence" between wolves and man. It doesn't work that way in theory (already discussed), and hasn't worked that way in practice.

There have been numerous modern wolf-control programs in Alaska. Results from only two (the Tanana and Minto Flats) areas are even suggestive that light moose harvests by humans are sustainable without pushing prey populations back into the "predator pit." In the Tanana Flats, which have supported significant human harvest pressure on wolves from traditional trapping and incidental wolf harvests by human hunters (as well as the ADF&G trapping program terminated by the "watchdog's" TV escapade), modest harvests of bull moose have been sustained for approximately 20 years. However, the Department is now moving

to reduce the human harvest of bull moose because of low bull to cow ratios. Hence, it appears that even in the Tanana Flats, the level of sustained wolf harvests by man has been insufficient to keep wolves from "getting on top of" the Tanana Flats moose population. In the Minto Flats, consistent harvest of wolves by trappers has prolonged the positive results of wolf population reductions.

If the multiple equilibrium theory were generally applicable to Alaskan predator/prey systems, the need for recurrent human harvest limitations or subsequent wolf control efforts (such as has been historic in the Fortymile River country over time) should be absent. They aren't. Hence, I conclude the Department's pulsed wolf reduction programs ultimately fail because of flawed biological understanding about the nature of predator/prey dynamics. The flaws lie not in multiple equilibrium theory, but in faulty application of the inferences drawn from multiple equilibrium theory.

If my conclusion is correct, the first requirement for successful predator/prey management in Alaska is Departmental reassessment of its assumptions about predator/prey population dynamics. Investment in "predator pit theory" has driven the Department to embrace the concept (inferred from its behavior) that the only successful way to control wolves is a pulsed, high-volume wolf killing program.

If a paradigm shift away from this mind set is to occur, I suggest it will require the Department look more toward long-term experience and evolutionary competition models than strained application of mathematically complex models which don't produce the predicted results. Alternatively, it would be productive for the Department to consider models from disciplines outside of the specialized area of predator/prey dynamics as it has defined itself. Several less complex thought systems more satisfactorily explain predator/prey relationships.

As previously suggested (Heimer 1996), a simplified model from basic enzyme kinetics predicts more simply and is conceptually more accurately

than the Departmental interpretation of multiple equilibrium.

Similarly, a model from electrical physics predicts more simply and shows more accurate description of long-term trends than the multiple equilibrium model. It is Ohm's law of electrical resistance ( $V=IR$ ). Manipulated algebraically Ohm's law becomes,  $I=V/R$ . Please recall that current flow is inversely proportional to resistance in electrical circuits. If we were to simplify predator/prey dynamics by looking at it from a broader perspective, we could consider predation a simple component of overall environmental resistance to prey population increase. This simply predicts that lowering environmental resistance ("R" in the manipulated equation) will result in increased population growth ("I" in Ohm's equation) if the force ("V" the driving "pressure" of voltage where Ohm was concerned) remains constant. I suggest "V" is analogous to the biological reproductive capacity of prey populations, and remains fairly constant. The prediction is that lowering environmental resistance will allow greater realization of biological reproductive capacity and result in prey population increase.

This simplification would demystify predator/prey biology. Instead of a complex non-linear function requiring advanced mathematics, we would be left with a simple relationship which predicts that incremental lowering of environmental resistance will result in an increase in prey population growth.

Here, it may be worth noting that this simple approach to population dynamics is closely related to the well-accepted basis of nutritional carrying capacity theory. The major difference is that nutritional carrying capacity theory operates on prey productivity rather than prey mortality. To work, both must operate in the "linear" portion of the curve. The problems inherent in management application are also similar for both theories. Harvests of predators (in this instance) or prey (where nutritional carrying capacity is a concern) must be effectively applied before populations have stabilized at asymptotic levels (in these cases,

nutritional carrying capacity of habitats—whether the food species be plants or ungulates).

Finally, the human social choices between predator and prey might be explained by borrowing a concept from the field of economics. Initially, readers may find this strained, however, the definition of economics is most simply stated as the study of allocating scarce resources to supply the demands of competing factions. With respect to predators and prey in today's social environment, this application could represent a significant step forward. In economic terms, limited resources demand maximization, maintenance, and determination of some balance between competing users. This approach realizes (like the Department's failed statewide wolf policy/plan) that not everyone's wants will be supplied to their full extent.

From an economist's perspective, understanding this balance requires consideration of "income" (the analog of biological recruitment), "levels of competition" (the analog predation), and the role of "market forces" (hunter/trapper pressure as well as government intervention through biological control programs). As in complex economic systems, the predator/prey issue can be conceptually reduced to "supply and demand." While this reduction of predator/prey theory to a model from the "social sciences" probably won't appeal to some who prefer nouveau chic mathematical models, its simplicity and social relevance should be obvious. Simply stated, the model simply represents how a resource can be allocated to competing demand interests. Inputs are finite and limited, and therefore output must necessarily be limited as well. In this "economic" case, biological productivity is the input and allocation of outputs can be equated to the traditional "guns and butter" of basic introductory economics (K. Martin-Gordon, Alaska Dept. Nat. Resources, pers. commun.).

Both guns and butter are necessary to society; the interesting question becomes, who decides how many units of guns and butter are produced. The choices to satisfy demand are as follows: produce all guns, produce all butter, or produce a mixture

of guns and butter. Obviously, the first two choices are not logical if society needs both, but rather a compromise must be reached which will provide both guns and butter to the economy. The refined problem then becomes how to allocate scarce resources to maximize market satisfaction. For every unit of guns produced correspondingly fewer units of butter can be created.

Likewise, with the "economic choices between" predator and prey populations, an analogous inverse relationship exists. Add more wolves, get less moose (or caribou or Dall sheep). Subtract wolves (effectively decreasing the demand for ungulate prey); get more moose (or caribou or Dall sheep). Hence, the question becomes not how much input (money or prey) we have, but how we decide to alter the balance between guns and butter (wolves and ungulates), and what biological/harvest balancing methods will be used to achieve those levels. While this model isn't rocket science, it rather simply states the relationship between predator and prey populations in basic, but practical, economic (allocation of scarce resource) terms.

Without realizing it, the Department-sponsored statewide planning effort came close to applying this model. Unfortunately, when that effort collapsed, Departmental leadership reacted by more tightly embracing its limited understanding of the multiple equilibrium model and the *planning process* rather than choosing a more productive "guns and butter" model. In short, the Department retreated to the esoteric science of predator/prey biology rather than pursuing the more relevant socio-economic approach to solving the predator/prey problem.

Considering predation from any or all of these three perspectives (enzyme kinetics, electrical physics, and economics) should lead to the hypothesis that sustained, appropriate levels of wolf harvest will be more biologically effective in producing prey for human uses than the major, pulsed high-volume wolf killing efforts inferred as effective from questionable application of multiple equilibrium theory.

History suggests the attractiveness of this approach. When Alaskans used to harvest wolves more aggressively in the days of less restrained competition, prey abundance was generally higher because environmental resistance was generally lower. This generality is in concurrence with predictions of the Department's better contemporary iterative models (see McNay 1998). Additionally, a stable, long-term wolf harvest program, once established by liberalizing wolf harvest methods and means, would not draw the attention of non-competition advocates geared to respond to the "specific crises" associated with large, pulsed Departmental wolf-control programs.

Consideration of Ohm's law (of predation), enzyme kinetic models or the economics of "guns and butter" would simplify management, but might take much of the fun and mystique from predator/prey biology. There is great intellectual satisfaction to be gained from understanding processes at their most basic level. I hypothesize this intellectual gratification drives much modern predator/prey research. At present interest in the "micro-dynamics" of predation (as represented, by the National Research Council's approach to reviewing individual predator control programs) have become the research norm. Unfortunately, even if these micro-dynamics are knowable, their relevance to the larger picture is too-easily overlooked. It's become a sort of "forest for the trees" situation, which I shall illustrate with a final chemical analogy.

We all know that putting a teaspoon of sugar in a beaker of water and stirring it will sweeten the water as the sugar dissolves. We also know that the more sugar we add, the sweeter the water will become. However, in the mechanics of stirring, the stirring rod generates and sheds vortices as it moves through the water. Some of these "mini-tornados" will be more effective at sweetening than others because they will pick up more crystalline sugar from the bottom of the beaker and whirl it into solution. We can't characterize the exact dynamics of sugar dissolution in each vortex. Some might contain lots of sugar, some virtually none (depending on the localized circumstances).

If we would study the sweetening effect of sugar in water by trying to assess the dynamics of each individual vortex, we would become greatly frustrated by the variation between vortices. Given enough time and sufficiently sophisticated technology coupled with descriptive mathematics, we could eventually build a model which could sum the effects of all vortices, thus predicting with statistical assurance that water will eventually be uniformly sweetened. However, our confusion resulting from vortex variability will in no way change the fact that the entire contents of the beaker will be sweetened. Neither will it change the fact that the water will be sweetened in direct proportion to the amount of sugar added, up to the saturation point.

In predator/prey biology, we seem to have become so interested in individual vortices that we've overlooked the proportional nature of sweetening. In summary, my suggested prescription is:

First, the people of Alaska should decide whether arbitrary human withdrawal from competition with wolves is acceptable when driven by the ideology of one individual, Alaska's Governor. In truth, that's the Alaskan situation at this time. Certainly the Governor is driven by factors which he sees as maximizing his inclusive fitness, but the decision will rest with the Governor, as long as he/she controls the function of the Commissioner and the Alaska Boards of Fish and Game. The Governor appoints both.

Second, the Department should reexamine its assumptions about predator/prey relationships, particularly those which seem to be driven by casual analysis of multiple equilibrium theory and where the "logic of language" associated with "multiple equilibrium" jargon has taken it.

Third, the Department should simplify its models from the very complex (such as multiple equilibrium) to any of the number of simple models which better describe the overall predictable effects of predation on prey abundance.

Fourth, the Department should revisit and recap-

ture the diversity of prey uses based on land ownership which was virtually within the grasp of all users when "winner take all" wolf protectionists "blew it up" prior to the threatened ecotourism boycott. Care should be taken to separate the "functional economics" of this model from its "public process."

Fifth, the Department should invest in informing the Alaskan public about the basic thinking and political expediencies driving predator/prey research and management.

Finally, the Department should embrace increasing consistent, lower-level mortality on predator populations where more prey are desirable for human use, and step away from pulsed Departmental mega-kills of wolves. These pulsed wolf removals are of questionable utility in the long run, very expensive, difficult to administer, dangerous to biologists, and easily defeated by folks who don't consider the historic competition for prey animals between wolves and men appropriate for ideological reasons.

#### LITERATURE CITED

- Ballard, W.B., J.S. Whitman, and D.J. Reed. 1991. Population dynamics of moose in South-Central Alaska. *Wildl. Monogr.* 114: 49pp
- Harbo, S.J., and F.C. Dean Jr. 1983. Historical and current perspectives on wolf management in Alaska. *In Wolves in Canada and Alaska; Their status biology and management*, Ed. L.N. Carbyn, pp 51-64. Canadian Wildlife Service report series #45, Ottawa.
- Gasaway, W.C., R.O. Stephenson, J.L. Davis, P.E.K. Shepherd, and O.E. Burris. 1983. Interrelationships of wolves, prey, and man in Interior Alaska. *Wildl. Monogr.* 84. 50pp.
- Heimer, W.E. 1996. A new look at predator-prey interactions using a simple enzyme kinetic model. *Proc. Bienn. Symp. North. Wild Sheep and Goat Council.* 10:14-19.

\_\_\_\_\_, and R.O. Stephenson. 1982. Responses of Dall sheep populations to wolf control in Interior Alaska. Proc. Bienn. Symp. North. Wild Sheep and Goat Council. 3:320-329

Keith, E. 1979. Hell, I was there!: Elmer Keith, his life story. Petersen Pub. Co. Los Angeles, CA.

Keeler, L. 2000. Listen to All. Guest Opinion, Fairbanks Daily News-Miner. March 4, page A-4.

McNay, M. 1998. PredPrey model. Fed. Aid in Wildl. Rest. Final Rep. Grants W-24-1 and W-24-5 (July 1992-1997) Alaska Dept. Fish and Game. Juneau, AK. Compact Disk.

National Research Council. 1997. Wolves, bears, and the prey in Alaska. National Academy Press. Washington, DC. 207pp.

Rearden, J. 1999. Alaska's wolf man, the 1915-1955 wilderness adventures of Frank Glaser. Pictorial Histories Publishing Co. Missoula, MT. 330 pp.

Stephenson, R.O., Ballard, W.B., Smith, C.A., and Richardson, K. 1995. Wolf biology and management in Alaska, 1981-1992. Pages 43-54 in L.N. Carbyn, S.H. Fritts, and D.R. Seip *Eds.*, Ecology and conservation of wolves in a changing world. Canadian Circumpolar Institute, Edmonton, Alta. Can.

Walters, C.J., M. Stocker, and G.C. Haber. 1981. Simulation and optimization models for a wolf-ungulate system. Pages 317-338 in Chas. W. Fowler and Tim D. Smith *eds.* Dynamics of large mammal populations. J. Wiley and Sons. New York, NY. 447pp.

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## QUESTIONS, ANSWERS, AND COMMENTS-WAYNE HEIMER PRESENTATION

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**GLENN LORTON, NEW MEXICO:** What part do Natives play in predator control?

**WAYNE HEIMER:** It's difficult to categorize Alaska Natives because the inclusive term "Native" includes so many diverse groups. Some groups, depending on culture and village experience have a greater interest in wolves and taking wolves than others. Some villages have very active histories, for others there is little documentation. Throughout Alaska as a whole in recent history, I would say the impact of Alaska Natives on wolf populations has not been significant. Hunting and trapping wolves is not the priority it used to be. Fur market forces and changing traditions are factors. Would either of you other Alaska Fish and Game guys like to offer comments on that question?

**KEN WHITTEN, ALASKA:** Basically that's true, except that for wolf control almost all is done by urban whites.

**HEIMER:** He said predator control is an issue for urban whites. To which I would add, with a cultural history involving relationships with wolves. However, there are political aspects of the issue which greatly concern Alaska Natives. These political issues involve ballot initiatives to protect wolves from harvest.

The first of these ballot initiatives was to prohibit harvest of wolves on the same day a hunter had been airborne. It was placed on the ballot by wolf protection interests primarily financed by sources outside of Alaska. There was no organized opposition to the initiative, and a well financed campaign in favor of its passage. This campaign presented false advertising about aerial hunting which was calculated to capitalize on the emotions of urban women predicted by campaign researchers to be the critical block of votes (D. Pope, initiative organizer interview with Anchorage Daily News). This initiative passed. Those interested in competing with wolves, including Alaska Natives took note.

The second ballot initiative grew out of the economic wolf-trapping incentive (largely financed by FNAWS) which resulted from the planning effort to recover the Fortymile caribou herd mentioned earlier. The primary tool of the effective trappers involved in reducing wolf populations (to the point the Department could experiment with sterilizing alpha pairs) in the Fortymile was snaring. Buoyed by their success in the previous election, wolf protectionists again placed a wolf protection initiative (banning of snares to trap wolves) on the ballot. This issue galvanized Alaska Natives on the predation control issue. The Alaska Trappers Association approached Alaska Natives and formed a coalition with them to oppose this initiative.

In this election campaign, Alaska Natives and trappers out fund-raised and out campaigned the wolf protection interests. The campaign strategy to defeat the anti-snaring initiative focused on preserving the Alaska Native life-style of trapping. In reality, data showing intense dependence on snaring by Alaska Natives weren't there. This didn't stop initiative opponents from exploiting pro-Native public sentiment to defeat the initiative to ban use of snares by a large margin. This empowering action established Alaska Natives as a major player in harvest and trapping issues.

*[Author's note: As of March, 2000, predator control is not an "urban white issue." In the time since aircraft*

*supported harvest of wolves was banned through the initiative process, wolf populations surrounding several important Native villages on the Yukon and Kuskokwim Rivers have apparently increased. Reports of wolves coming into villages to capture and eat sled dogs on their chains have become commonplace, and moose populations critical to the human food supply in these villages have been depleted. In the eleven months which have passed since this conference, Alaska Natives living in these villages have petitioned the Alaska Board of Game for predator control in their areas. The Board of Game has passed enabling regulations, but the Governor has blocked their implementation. Alaska Natives in these villages are now demanding, not only that predator control be done in their areas, but that they be the ones to do it. At least two villages with leaderships involved in resisting the snaring initiative have instituted economic incentives apparently inspired by the Fortymile Caribou Calf Protection Program-pioneered trapping subsidy discussed earlier. Hence, during the eleven months since this conference was held, the situation has changed radically. Additionally, the Alaska Legislature eased restrictions on aerial wolf hunting somewhat after the two year prohibition on amending a voter's initiative ended, and appears to be "on track" to allow remove wildlife issues from ballot initiative modification. Much of the impetus for these changes is driven by rural Alaska Native dissatisfaction with the Governor's present wolf management policy. "Wolf control, it's not just for 'urban whites' any more." WHJ*

**WHITTEN:** Alaska presently has wolf trapping seasons with very liberal (unlimited in many areas) bag limits, (wolf harvest seasons are much longer than prey harvest seasons in general), and still we don't actually limit wolf populations. As a matter of practicality, I don't think there's enough public interest and participation in harvesting wolves to manage wolf populations in Alaska. I doubt that Alaskans will ever harvest the 15 to 20 percent of wolves Wayne suggests would be required for humans to compete effectively with wolves for prey.

**HEIMER:** What's the estimated sustainable harvest level from Alaska wolf populations?

**WHITTEN:** It's the same as harvesting sheep; it depends on the population. If you have a vigorous wolf population with a high prey base, you can harvest over 50 percent [of a wolf population on a sustained basis]. Harvest by hunters or trappers is not allowed until recruitment of pups is pretty much assured. If you have a wolf population on a less abundant prey base you can't support that much harvest. The estimated 20 percent harvest rate that we take across most areas of the state isn't affecting wolf populations, but there are some accessible areas around the river centers where wolves are depressed at times by harvest.

There's some work going on now. Eric's work, certainly. John Wehausen's work in California sure appears to be that way, and Ian Ross' work in Alberta. But I think there's a real lack of good, solid data that shows interactions between sheep populations and predator populations. With that, I'd throw it out to you all again, especially the researchers and managers in the room that have feelings or data concerning this topic.

**RAY DEMARCHI, BRITISH COLUMBIA:** I said it before and I'll say it again. I just concluded a couple of status reports and did some work on Stone's sheep in the Northern Rockies, and I tried to sort out this whole predator/prey thing. I wrote some stuff earlier on predators and have a little bit of experience working with the wolf recovery program down into Montana.

I'm as confused now as I ever was. The title of my talk is "Man as part of nature." Game management works. If you want more ungulates, there's ways to do it; improve the habitat, reduce competition for forage, reduce predation, all of the above. If you don't have the habitat and you have predators, you're going to have problems.

I came to a region where I spent 28 years managing 11 species of ungulates and 8 species of animals that eat meat every day. I kept reminding people they didn't eat corn flakes. They ate meat.

We came on the heels of some of the biggest fires we had in the 1930's, but the forests are coming back in. I'm hearing stories about sheep herds that are disappearing up north.

There are herds that are gone. They didn't die this time from *Pasteurella*. They died off from predators and people are blaming the predators.

I look at the habitat and I look at what's happened. As forests move in, the advantage goes to the predator. What happened with the elk and the black bears way back when, it's happening with moose and wolves, it's happening with caribou and cougar, it's happening all over. In some cases, opening up the habitat makes more access for wolves and black-tailed deer. It depends on the situation; every situation is different.

I think that in some places in my beloved province, people are practicing wolf control. I don't know who is doing it but somebody is doing it. It's unfortunate that this has been done behind the scenes, because it's probably not being done right, if there is a right way of doing that kind of stuff.

Still it's a very complex issue. Just sitting here listening to the conversations and the session today, I think I have to go back and rewrite a couple of things that I wrote. One guy is saying coyotes are hard on sheep and lambs and other people say that wolves are hard on Stone's sheep. Why would the wolves be different? Maybe they are, or maybe they aren't. I think the jury is still out.

**KEN WHITTEN, ALASKA:** I think Ray hit on it and other people have too; predation can be a problem. It's not always a problem and I think often where we get caught up in these political wars is by thinking that the animal rights people are on one extreme, so we'll fight them by going to the other extreme. We don't need to kill wolves everywhere in Alaska in order to reduce problems in the few places where we have them. You don't need to kill mountain lions throughout California to save the Sierra Nevada bighorns. You have to look at these things on a case-by-case basis.

Another point I'd like to make is there can be innovative solutions to predator control. We have, I think, adequate predator control programs on the books. The problem is ballot initiatives basically overrode four of



them. The ballot initiative pretty much closed all loopholes of public taking of wolves with airplanes.

As far as the department goes, we can't do lethal predator control with aircraft and there's a few other conditions on it. The one program we sometimes have going involves capturing wolf packs basically catching the entire pack, sterilizing the adult males, taking the juveniles out, transplanting them to other areas of the state. It's very expensive. Costs much more than shooting them from helicopters would be. The problem is, politically we haven't been able to shoot wolves from helicopters and we are now doing this. It looks like it's working, and it's been successful in that the sterilized males are maintaining their territories.

Transplanted pups, with very few exceptions, are not coming back. We take them far enough away, and they can't find their way home. We've been specifically able to target packs on the feeding ground.

**WAYNE HEIMER, ALASKA:** There are alternate interpretations of what went on. On this groundbreaking sterilization program, what you end up with when you want to do the research, you want to know which lion it is that's killing the sheep, and you want to know which wolf is the problem.

I think, in trying to express it, you're basically attacking an analog question looking for a digital answer. This also happens with the disturbance studies and some of the other things we do. We look under the microscope at this thing or that thing and it works or doesn't work. Our governor doesn't want to do any wolf control. He doesn't control the Board of Fish and Game which makes the regulations. A number of powerful native communities wanted wolf control because the wolves were eating all the moose they wanted to eat.

Our governor took a third of a million sportsmen dollars to contract with the National Resources Council, to have them review the published work of the Department of Fish and Game to see if it's scientifically valid.

As I understand the report, by the time they had looked at the successful wolf control programs, and those that hadn't been quite so successful, and those that were halfway in between, they basically said, you can't really be sure what you're going to get. Wolf control is like a box of chocolates; you never know what you're going to get.

If I may be allowed a homey analogy from your chemistry lab days. If you take a 250 cc beaker, fill it with water and put 20 grams of sugar in there and take a round stirring rod, and you begin to stir, what happens as you drag the stirring rod through that aqueous environment? You set up little vortices that come off of those and there's a little turbulence at each place. We cannot predict what's going to happen in any individual vortex that comes off the stirring rod. If you stir it, and you taste, it's all going to taste sweet. It's pretty homey and it's to suggest that we use Ohm's law as a management model.

But the point is, you can look at what has happened out there in our 40 mile country and, I'll suggest to you from the planning documents and what I know of the situation, we would never have had few enough wolves that we could approach the sterilization program had not crazed red-necks put a bounty on wolves. They did and the department can go ahead and try that thing. Some folks told you it's working, some folks don't think it is working. I don't know whether it's working or not.

But by the time you take a little snapshot of a vortex in your beaker here and another one over here, and you find them consistent, but you say you don't know what's going to happen, you're asking me to believe that when you stir up the sugar, it isn't going to taste sweet. I have a difficult time chasing those things through the absurd extreme, and they don't seem logical to me.

To say we need a bunch of research looking at individual vortices to see if the beaker will eventually be sweetened I find is strange. I think environmental resistance, as Ray said, comes from a number of components. Some of them we can manage, some of them we can't.

If it's the priority of society to have more game for people, we know how to do that. It isn't that hard if society's priority is more game. If this isn't society's priority, there will be a struggle and it will go the other way.

**JEFF DENTON, ALASKA:** What I'm interested in, in Alaska where our sheep are, does climate affect those populations, trimming off the old periodically? Do you consider wolves a problem in Alaska within relatively stable situations?

**HEIMER:** As long as everything is going great, which includes not just a lot of sheep, but includes a lot of caribou and moose, and includes favorable weather. As long as everything is going good, I don't think that wolves are going to beat up on sheep particularly.

They're going to kill them all the time and my observations are probably they will kill adults and not lambs. When caribou go down the tube or moose go down the tube, sheep are going to support those wolves.

Dave Mech's work in Denali Park at one point suggested the major factor associated with successful whelping in wolves in Denali Park was how many sheep they ate. Is that because sheep are an aphrodisiac of some kind? What was probably going on in the park at that time was that moose had been eaten and the caribou were pretty well on the way to being eaten, and wolves that were eating sheep would be okay. When things aren't good with alternate prey, if you want to have sheep, you have to decide whether you want to have an unmanaged ecosystem or whether you want to have sheep.

**JEAN CAREY, YUKON:** What's happening next door is we just completed a five-year wolf reduction program to enhance a caribou herd. Wolf numbers were reduced by 70 percent over 5 years. Moose populations increased and caribou populations increased, but sheep didn't.

As a follow-up and part of the legal control, we also are doing non-lethal control sterilization. To date, we have six packs that are sterilized. None of the pairs produced pups. They've all maintained their territories, and we feel we're extending the benefits for moose and caribou of wolf control through nonlethal measures.

In addition, a master's thesis done in Yukon suggested that wolves with only sheep to eat were having no pups at all. Wolves surviving on sheep alone seem to be in desperate conditions.

**HEIMER:** The research option is: which "vortex" do you want to study? (See thornhorn working hypothesis predator section for more detailed review of wolf/sheep studies in U.S. and Canada.)

*(Note: During the June 2000 meeting of the Northern Wild Sheep and Goat Council in Whitehorse, Yukon, I had the opportunity to interview R. Hayes (Yukon Territory wolf specialist) about final impacts of the wolf control program on Dall sheep. In discussion of the overall impact, Hayes reiterated no statistically significant changes in lamb: 100 ewes or yearling:100 ewes ratios had been seen. However, he stated the investigators had always suspected their wolf-project sheep count area used to measure the effects of wolf control on sheep was too small. When they finally secured funding to census the entire area affected by wolf control (after the project had ended), they found the number of adult Dall sheep had increased by 35 percent*

*when compared with the pre-wolf control total count. This finding supports the conclusion that wolf predation focuses on adults, and that assessment of lamb or yearling ratios is an inadequate methodology for assessing wolf control impacts on Dall sheep populations. The finding was too late to include in the monograph reporting on the Yukon project. It had already been accepted for publication.)*

**RYDER:** Just to switch gears slightly to try to accommodate all the various portions of the country represented here today. I'm curious, we've been talking the last ten minutes or so about the large contiguous blocks of habitat in the northern part of the continent. How about the Rocky Mountain or desert states? When we're dealing with sheep populations that are fragmented, most folks I talk to say lion predation is increasing across the western U.S.

What do you folks see in your various states concerning sheep population dynamics and predator populations? Even if you don't have any solid, hard core telemetry data, just feelings and observations you make in the country, please share these.

**WALT VAN DYKE, OREGON:** We have some bighorn populations in southeast Oregon that were doing quite well up until the winter of 1992-93 which was a very tough winter. It knocked our mule deer populations down by 50 percent. Most of our sheep coinhabit areas with mule deer. We know we've got an increasing lion population. We've not seen any rebound in bighorn sheep since that tough winter. We get lamb production, but we don't get lamb survival. In some cases, we do get good lamb crops, but the adult mortality appears quite high.

We've had 20 percent annual mortality of radio collared ewes in our transplants. In some real good desert habitat that also has sheep in it, we have 20 percent annual mortality of adult mule deer. I think we've got some problems.

We came from a period of drought prior to that tough winter. Drought had a lot to do with the impact of that winter on both mule deer and bighorn sheep, but now we've had five wet summers and mild winters and looking at logically, we expect that things should have really rebounded. We had better recruitment in mule deer and bighorn sheep during the years of drought than we've got now.

There's been some talk about density dependency. When you cut your mule deer population in half, especially going into five wet years, you should see a tremendous response in mule deer production.

Where we've got both species in the habitat and there's the argument that ecologically we've moved towards climax, and we no longer have habitats that can support mule deer, I can buy that. But that means that habitat should be better for bighorn, but there's nothing to suggest this is true. We've got a problem somewhere.

**RYDER:** Another thing that seems to be concurrent in Wyoming, I observed the same thing in 1992-93; a big decline in our mule deer populations. There were several sheep die-offs at roughly the same time, yet little recovery has occurred in some of those sheep herds. Deer populations generally are also still depressed. With that, we've seen an eruption in our elk herds statewide. That may not be as much of a factor with depressed mule deer numbers, although there may be some competition going on there. If elk increases are occurring in your states, how have they affected your sheep herds?

**VAN DYKE:** There are no elk here. We can't blame this on elk. Antelope are not doing well at the same time.

**VIC COGGINS, OREGON:** In our case in Hell's Canyon, as far as transplanted sheep, we have small herds that we think have been held at pretty low levels by predation, but it's an opinion. We don't really have any kind of solid information.

As far as our elk herds, that's another story. We have sheep herds that have been devastated, in my opinion, by predation. We have some at 20 percent of their management objectives, and of course the sheep that are there were involved in the die-off. We have not seen much predation on them, at least at this point, but I don't think any of our problems are related to high elk numbers.

**JIM BAILEY, NEW MEXICO:** I would like to say you didn't do very good justice by saying that it's based all on spruce budworms. There's evidence to support the two stable states model. Some of it comes from epidemiology (May and Anderson). A lot of it comes from predation and the model really has a lot of concepts in it. One of them is predator/prey relationships are important and it's been around at least since Doug Peinlock and Dave Mech's first book.

Another issue is functional and numerical responses. The concept of territorial among predators is biological information that supports the model.

**HEIMER:** Can you explain what that is for me?

**BAILEY:** Well, the rate of predation per wolf varies with the prey, and the number of prey out there also varies, but the plateaus in both cases vary with prey density.

Those are concepts in part of the model. Messier worked on that in eastern Canada with respect to wolves, and lots of other things with species that have shown the same thing. I think it's a good model. I'm not going to base my management on it so much as I'm going to use it as a really valuable thinking tool.

The issue of habitat was brought up here, too, because that alters and puts limits on the functional responses of killing rates of predators and prey. It's a good teaching model. It allows us to put a lot of complexities together and see how it relates; I don't think you did justice to it.

**HEIMER:** I'm sorry if I didn't do justice to it. I do think of it as a teaching model, a theoretical model, fine, but you have focused the entire responsibility for predator manipulation in the government sector, where it's so readily politicized. My suggestion is that while it may be a wonderful model, it isn't serving us well in management.

**BAILEY:** It's a good hypothesis of where we are. Where we are with small populations, populations that have been brought into the break point, into the predator pit, where we are today down here in the south, with really small populations. We're in the pit, and we can't get out. We don't have habitat.

**HEIMER:** Or we've got too many predators. You can take your pick.

**BAILEY:** The amount of predators is related to the amount of prey. Supporting the predators is the issue. That can be built into the model.

**DALE TOWEILL, IDAHO:** This is one of those issues that it's really, really critical that we understand

exactly what we're talking about.

When we're talking about the individual, all mortality is additive. It's only nailed once. Predators may switch off prey, going back to the concept of compensatory mortality. It's been generalized but that's the basis of it. Basically, if the prey species of interest produces more young than the habitat will support, other animals will knock them off, with no net effect on the subsequent birth pulse.

Compensatory mortality is time dependent, area dependent, and species dependent. Predators switch off. So while it's a convenient learning tool and we were all taught it, don't let it disintegrate into jargon. Be very specific about your area, your population, your alternate prey, your production and the predators of interest.

**RYDER:** Thanks, Dale. I want to thank you all for your input and to thank Wayne and Eric for their presentations.