Reexamination of 2001 Wolf Radio-Collaring Deaths in Denali National Park

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Introduction and Summary

In March 2001, three wolves died in Denali National Park during or shortly after radio collaring by Dr. Layne Adams, a U.S. Geological Survey biologist who does research in Denali for the National Park Service (NPS). Two of the three dead wolves were alpha animals from the famous Toklat and Sanctuary family lineages of eastern, road-accessible areas of the park (“family” is the proper and most descriptive scientific term, not “pack” – see Appendix I). NPS announced these deaths in a press release a few days later, triggering widespread

interest among Alaskans. NPS investigated the deaths, convened an expert review panel, and issued its conclusions in an early-May press release and report.

NPS concluded that (a), at least two of the three deaths most likely happened because heart valve irregularities predisposed these wolves to higher anesthetic risk, (b), Adams followed proper protocols and exercised good judgment in his radio collaring procedures, and (c), while highly regrettable, the deaths were of little biological or other consequence. There were no recommendations for any major changes in collaring procedures, only for gathering more information about the incidence of heart valve irregularities in the population at large.

I do intensive year-round wolf research in Denali and was present for most of Adams' collaring activities while doing my research. I saw no indication of anything intentional by him or anyone else in the March 2001 radio collaring deaths. However, I take issue with virtually all of the NPS conclusions, based on my observations of what happened and research familiarity with the Denali wolves:

The heart valve explanation for at least two of the three March 2001 deaths is little more than speculation. There was no direct evidence of a causal relationship. A more likely explanation is that Adams unknowingly darted these wolves with a drug intended for moose or caribou, because of the similar appearance of the darts and dart guns used for the three species and his routines in carrying, preparing, and opportunistically using the different darts together on the same helicopter flights. Adams exercised poor judgment in subjecting the Sanctuary alpha female to the inherent risks of darting at a time when the survival of that family lineage depended almost entirely on her, by replacing the Toklat alpha male's collar well before this was necessary, by undertaking capture activities without regard for the timing of the wolves' all-important courtship and mating activities and pregnancy, and in other ways.

He showed even worse judgment in closely approaching the four Toklat wolf pups with a helicopter five months later, on September 29, 2001 – when they were only 4-5 months old - in order to separate out the new alpha male for radio-collaring. None of the four pups has been seen since then. It is likely that they scattered in panic in response to the helicopter. They then may have become lost, with little chance of surviving for long on their own.

It should be possible to exclude such carelessness and poor judgment in determining causes of the March and September losses but is not, because NPS has not met its burden of oversight to ensure high collaring standards. Perhaps worse was NPS's superficial investigation and review of what happened in the known collaring deaths. NPS officials did not interview key field witnesses. They did not attempt to secure the recovered wolf car-

casses for full investigative and scientific benefit. Neither NPS nor its review panel considered most of the obvious issues and questions raised in this report.

NPS, its expert review panel, and Adams are misguided in dismissing the biological and other consequences of the 2001 collaring deaths. It would be difficult to imagine many biological consequences of greater impact than have resulted from the loss of Sanctuary and predecessor family lineages, the "experimental" genetic and behavioral disruption and reformulation of Toklat, and the compromising effects of these losses and changes on their world-class research values. There are also major ethical and esthetic concerns from which at least NPS is not excused, and there have been and likely will continue to be major wolf-viewing losses for many thousands of visitors in the most accessible area of the park.

This is only the latest manifestation of NPS's refusal since the early 1990s to adhere to provisions of its own, ANILCA-mandated, Denali General Management Plan (GMP) that emphasize the importance of individual wolf family lineages and need to protect them. NPS has even spearheaded (directly and indirectly) much of the recent opposition to a buffer zone that would have protected the famous eastern groups (e.g., Toklat, Sanctuary) from hunting/trapping on their normal travels outside the park and in the 1980 (ANILCA) park additions.

However, even in the absence of a GMP, NPS would not be entitled to jeopardize these family lineages by allowing anything but the highest quality radio collaring, if only because of other statutory and regulatory requirements. NPS should apply a series of corrective measures immediately, to ensure much more care and oversight. These measures should include broader scientific evaluation before each round of collaring, clear separations of wolf vs. other collaring, participation of a qualified veterinarian, and restrictions against collaring wolves other than in November through the third week of February, when they are in risky terrain or vegetation situations, when they are at kills/winter kills or otherwise likely to have eaten large amounts recently, when they are known to be outside their territories, within their territories where hunting/trapping is permitted, or where there is current or impending human activity of any kind. Any collaring mishap should trigger an immediate suspension of all collaring until there has been a proper investigation and scientific review and remedial measures are in place.

It should be noted that several top Denali officials recently transferred to new NPS positions outside Alaska. This included the superintendent, chief ranger, and chief of research and resource preservation. A new superintendent and chief ranger are on the job but the third position has not been filled yet. Obviously I see fundamental problems with most of the NPS policies, procedures, and other thinking considered in this review. However, the new

officials have had little if anything to do with these problems. They are not among the targets of my criticisms, at least with regard to events preceding their arrivals. They should be judged only on how they respond henceforth.

It should also be emphasized that these problems and recommendations are not unique to Denali or 2001. They are generally applicable wherever wolves are collared, especially in Alaska within other federal parks, preserves, and refuges as well as on state and private lands. In addition to my activities in Denali, I do extensive wolf research via aerial radio tracking in Yukon-Charley Rivers National Preserve and across state lands throughout much of the upper Tanana-Fortymile region. I have done similar research in other large regions of Alaska (e.g., GMUs 20A and 13). It is clear from my observations and the many hours of aircraft-to-aircraft conversations I have monitored (and tape recorded) while wolves were being collared that carelessness and poor judgment have been widespread for years, sometimes even with blatantly inhumane and other unlawful conduct.

Background

Wolf-ungulate captures and research in Denali National Park

As in most recent winters, Adams conducted two major wolf-ungulate capture operations in Denali National Park and Preserve during winter 2000-01 (October-April), one in October and the second in March. The March 13-21, 2001 operation, like most others, used two Super Cubs for locating and spotting (piloted in this case by Don Glaser and Dennis Miller) and a helicopter for darting and handling (in this case an R-22 piloted by Jonathan Larivee). Several Denali and USGS staff members assisted, primarily as observers in the Super Cubs.

During this and previous operations it was commonplace for Adams and associates to interchangeably dart and capture moose and/or caribou and wolves opportunistically on the same flights. Thus, several moose, then 2-3 wolves, then 1-2 more moose, then 1-2 more wolves might be darted and captured on the same flight, with the specific sequence determined by weather, suitability of the terrain for a capture, and other variables. In at least one case, darts were prepared (loaded with drugs, etc) in the field during a helicopter landing, just before the capture effort. Wolves were darted and captured only for collaring or recollaring. Moose and caribou were also darted and captured to determine pregnancy, weights, and for other physiological measurements.

2001 was my 36th year of research on wolves and wolf-ungulate systems in Denali. I aerial radio-track wolves throughout the park/preserve year-round and supplement this with

ground radio tracking and other observations in road corridor areas during the summer. During biological year 2000-01 (May 1-April 30), for example, I radio-tracked 15 groups of wolves regularly in the park/preserve, obtaining a total of 447 aerial relocations. I was present and in aerial radio contact with Adams' pilots on every day of his March 13-21, 2001 operation; during this period alone I relocated radio-collared Denali wolves 101 times. My research spans a broad range of objectives concerning the social organization of wolves and dynamics of wolf-ungulate systems. One of the objectives in March is to observe wolf courtship and mating behavior, particularly for the Toklat (East Fork) family. Courtship and mating takes place once a year, usually for 7-10 days between late February and mid March.

Neither Adams nor the National Park Service provides any significant assistance for my research. This includes the radio collar frequencies, which I must obtain independently. We have an "arms-length" relationship that derives from my decades-long oversight and criticisms of NPS management policies in Denali, particularly with regard to wolves. I have repeatedly challenged the scientific quality of the related research that Adams and other NPS contractees have conducted in Denali (e.g., Haber 1996, 1998, 1999, 2000). Nonetheless, Adams and I and our pilots communicate and coordinate closely in the air when we are radio tracking within the same areas at the same time, such as during March 2001. We do this in accordance with mandatory safety protocols developed specifically for our activities via the Flight Standards District Office of the Federal Aviation Administration in Fairbanks. These protocols require that all of our flying and aerial communications be done openly and that we are all aware of each others' locations and activities. The helicopter and its spotter Cubs must talk to each other in particular detail throughout each capture effort. This results in running accounts that my pilot and I are required to monitor whether we are within the immediate area in visual contact or are working further away. Thus we become privy to important details of most captures as they are happening.

<u>March 2001 wolf deaths – narrative of observed events</u>

Adams captured 10 wolves from five groups during his March 13-21, 2001 operation, three to replace existing collars and seven to add new collars. Three of the new collars were outfitted on one group, i.e., Otter Creek, following the apparent deaths of two of the collared Otter Creek wolves in separate moose encounters and the chewing loss of the third collar, all over the previous month and a half. At least two and possibly three capture-related wolf deaths resulted, one each in three groups – Otter (the "possible"), Sanctuary, and Toklat. I was present in Denali with at least radio contact for eight of the 10 wolf captures, including at

least one of the deaths for which I also had visual contact (while circling overhead in a Super Cub). I was also present with at least radio contact for most of the ungulate captures.

1. Otter Creek

Three wolves of the Otter Creek family were radio-collared along lower Moose Creek on March 14, 2001, from approximately 2:30-4:15 p.m. The helicopter and both spotter Cubs were used. I circled above in a Super Cub throughout the effort, as well as for about a half hour before and (at much lower altitudes) after. I remained in continuous radio and visual contact with all three of the collaring aircraft while they were present and, by agreement, stayed at or above 7,000 feet to maintain safe vertical separations. As of January 4, Otter consisted of 10 wolves with three active radio collars. All 10 of the wolves appeared to me to be in normal, good condition at the time, based on their behavior and the way they moved as well as their physical appearances. By March 13 all three of the collars were transmitting on mortality mode from stationary locations, as indicated above, leaving no further radio contact with the eight wolves still present on March 14.

Super Cub pilot Miller found the Otter wolves along Moose Creek at about midday, March 14, by snow tracking them. He radioed to the helicopter and other Cub, who at the time were involved in a capture effort some 20-25 miles southward. Miller remained with the Otter wolves until the helicopter and other Cub arrived, at which point the helicopter began singling-out, pursuing, and darting wolves. The predominance of scrub spruce in this area in combination with my altitude limited the detail that I could observe directly during the captures. I could see the helicopter and Cubs working and hear their conversations, most of which seemed routine.

I recall two exceptions. The first was when the helicopter closely pursued a wolf along the frozen creek in a section of tight bends. I was surprised at how close the rotor blade seemed to be coming to the higher spruce trees that lined the creek as the helicopter maneuvered around the tight bends in pursuit. I was struck both by what seemed to be a safety risk and a high risk of losing the wolf once it was darted, given that it could easily veer into the adjacent forest cover before going down (from the drug). The second exception was the lengthy period of time – almost an hour – that the helicopter remained parked at one of the capture sites. I could not discern any details of what was happening but wondered if there might be a problem.

I did not intend to check on these wolves again for several days, due to the press of other observations, especially relating to the Toklat family. On March 17, about 10:30-10:45 a.m., after retrieving the dead adult Sanctuary female (below) and bringing her back to the

Denali Park airstrip, the helicopter and two Cubs flew west to the upper Sushana area to dart caribou and/or moose. I was working at locations up to 10-15 miles northward at the time (in radio contact with the helicopter and Cubs), conducting observations on the Toklat, Lower Savage, and Stampede wolves. Within 15 minutes, Miller departed to the west, in the direction of the Kantishna Hills.

Less than an hour later he radioed back to the helicopter and other Cub to meet him (land) at Sushana Lakes "for a pow-wow … you need to hear this." It was obvious that he did not want me to hear about something he had just found. My pilot and I surmised that he radio-tracked the Otter wolves and found a related problem but did not speculate beyond that. I wanted to continue monitoring the Toklat and other eastern wolves so did not head to the Otter location (more than 35 miles westward) at that time. About an hour later I departed the park to the east for several hours, during which time the helicopter and Cubs retrieved a dead Otter wolf from somewhere near the March 14 capture location.

2. Sanctuary

Two of four wolves remaining in the Sanctuary family were radio-collared on a high plateau just inside the east park boundary on March 16, 2001, from about 3-4:00 p.m. The helicopter and both spotter Cubs were used. I circled above in a Super Cub for all but the first few minutes of the effort and made low passes to examine the drugged wolves for about 15 minutes afterward. I remained in continuous radio and visual contact with all three of the collaring aircraft while present and, by agreement, stayed at or above 6,500 feet to maintain safe vertical separations.

As of December 23, 2000, Sanctuary still consisted of nine wolves – a mated pair and their pups, possibly including one surviving pup of 1999 as well as the (6-7) 2000 pups. By January 4 only the adult female and three pups remained, the same four that were present on March 16. The adult male was killed during an encounter with a moose just outside the east park boundary (I examined him in situ on January 21; I also hiked to the site on January 8 but was prevented from examining him by this aggressive moose). There is strong circumstantial evidence that the missing young were killed by trappers after the eight remaining wolves lingered in and returned to this area, which was near the Parks Highway and a hotel construction site.

At 9:10 a.m., March 16, Super Cub pilot Miller radio-tracked the four Sanctuary wolves to the aforementioned location. I was observing the 10 Toklat wolves at that time, some 30 miles westward. The Sanctuary four were sleeping at the east edge of a high, mostly open plateau, with a ~1,500 ft, 45-50° rocky bluff dropping off to the Nenana River

below. There were 8-10 sheep in rocks below the wolves, but they could not have reached them and showed no interest. I flew to the Sanctuary location at 10:50 a.m., by which time Miller had left and was working further west with the other two collaring aircraft (they had not yet gone to the Sanctuary location). The wolves were still curled up, asleep. I then landed at an airstrip two miles to the east. Just before noon, while I was still on the ground, Miller returned to the area, circled low over the wolves several times, and then made a low pass over me, apparently to determine if it was me or another, similar-appearing local Super Cub. I took off shortly afterward and flew back westward, where I observed the Toklat and other wolves from about 1-2:30 p.m.

It became obvious from the radio traffic that Adams and the others were about to capture Sanctuary wolves for collaring. It was clear that he wanted to outfit the adult female - the only remaining collared wolf in the group - with a new collar but I wasn't sure if he intended to collar any of her pups. I returned to the Sanctuary location and orbited above the collaring aircraft. Their plan was to make a stealthy approach with the helicopter from the lower east side of the plateau (after landing on the east side of the Nenana River to take the door off, for darting), so the surprised wolves would run across the (downsloping) plateau to the west, *away* from the steep, rocky edge. At least two of the four did this, and the helicopter pursued and darted both of them – the adult female and a female pup - about 200 yards to the west. At least one of the others, a pup, ran into the steep rocks instead.

The two darted wolves were then recollared/collared and left at the same location in what appeared to be routine fashion. Adams remained parked about a hundred feet away in the helicopter for 15-20 minutes, apparently to observe the drugged wolves. Twice I saw someone get out of the helicopter and walk to the wolves to observe them briefly. The helicopter then departed at 4:00 p.m. (the spotter Cubs had already left), at which point - after communicating my intention to the helicopter - I descended for a series of low passes until 4:15 p.m. to examine the collared wolves more closely. The two wolves had been laid out in open terrain (with a few scattered willows) within 10 feet of each other, both primarily on their sides and with heads slightly uphill. The black pup was already beginning to stir somewhat, by raising her head a little and moving it around groggily. However the adult female remained motionless, without any indication of recovery. I made several additional passes specifically because of this obvious difference in the way the two seemed to be recovering but still could not see any indication of movement on her part. Before leaving I looked briefly for the other two wolves (the uncollared pups) but did not see them anywhere nearby.

I returned at 9:10 a.m. the next morning and immediately acquired signals from both collars – the adult female's signal from the same location, now on mortality mode, and the pup' s new collar transmitting normally from Riley Creek, about two miles westward. The collared pup was with her two littermates on the Riley Creek bar, and all three seemed bewildered. The adult female had not moved since I left the night before and was dead. At 9:20 a.m. the helicopter arrived straight from the park airstrip and landed at her site, as I circled above. The spotter Cubs were not with the helicopter. One person got out of the helicopter as it idled with the rotor turning, went to the wolf, and immediately dragged her back to the helicopter, whereupon the helicopter took off for the park airstrip. At the park airstrip I circled high above as the wolf was unloaded into a van.

I watched for about 10 minutes, then flew westward for observations of the Toklat, Lower Savage, and Stampede wolves. The two spotter Cubs, followed shortly by the helicopter, arrived nearby at about 10:30-10:45 a.m. and began ungulate capture activities in the upper Sushana area. It had been obvious that they wanted to capture at least one Toklat wolf for recollaring, and on the way to the upper Sushana this again was obvious from a conversation between one of the Cubs (Glaser) and the helicopter, in which they observed that, "they're all here" but in a currently inaccessible darting location atop Mt. Wright (where I, too, observed them, before and after). As described earlier, it was shortly after this that Miller flew further west and discovered that one of the radio-collared Otter wolves was dead.

3. Toklat

I returned the next day, March 18, for observations of Toklat, Sanctuary, Otter, and other (western) wolves. I expected that Adams would next recollar the Toklat alpha female. Her collar had weakened in signal strength, but I wasn't sure about the alpha male's collar (the only other collar in the group) given that it was still transmitting strongly. However there were no capture activities on the 18th, probably due to the high turbulence. This and their location in rough, brushy terrain also prevented me from obtaining a visual on the Toklat wolves.

Flying conditions were much better on March 19. I observed wolves – mostly Toklat and Sanctuary – from about 9:00-11:00 a.m. and 5:00-7:30 p.m. All 10 Toklat wolves were together just east of Savage River, well outside their established territory, north of the park road in the morning and to the south by late afternoon-evening. The helicopter and at least one spotter Cub (Miller) had been working to the west most of the day. At about 5:45 p.m. the Cub flew east to locate the Toklat wolves, who were now turning several miles eastward into

open hills east of upper Savage River. I knew the Cub was coming, so I flew about 10 miles further east and located the collared Sanctuary pup.

After locating the Toklat wolves, the Cub (Miller) radioed back to the helicopter that he had found "calf moose 934" and it was in a good location for darting. It was obvious that his reference to a moose was code - a ploy to try to mislead me from observing the Toklat wolf darting activities. After allowing the helicopter enough time to arrive at the Toklat (and Miller's) location, I radioed to the helicopter and Miller that I would be above them momentarily, to observe. We agreed that I would remain at or above 6,500 feet to maintain a safe separation.

I arrived at about 6:30 p.m., as Adams was already beginning to outfit the drugged Toklat alpha female with a new collar. She had dropped on the open, snow-covered lower south slope of a small east-west creek valley. I could see 6-7 of the other Toklat wolves, including the collared alpha male, standing in a single file line about 200 yards to the north, looking intently back at the scene (a few minutes later they retreated to the higher north side of the valley, still watching, a hundred yards or so further away). The Cub was already on its way back to the park airstrip for the night, after Adams radioed to him that he could leave. After outfitting the wolf with a new collar, Adams sat in the helicopter 75-100 feet away for 10-15 minutes while apparently observing her, walking back to check on her once or twice. At 7:00 p.m. the helicopter started up and took off for the park airstrip. We said good-bye to each other on the radio, at which point I descended for a closer look via lower passes and circling until leaving myself at about 7:25 p.m. The wolf was lying on her side, with her head perhaps elevated slightly upslope. She appeared to remain motionless throughout most of the period, possibly with a couple of slight movements of her head (but not enough to raise it) over the final five minutes of my observations.

I was back the next morning, March 20, at 8:45 a.m. The alpha female, alpha male, and at least three other Toklat wolves were curled up together, sleeping, about 200 yards north of the capture location. There was no obvious indication of any lingering problem from the capture. I then flew east to the Sanctuary capture location, where the newly collared and newly orphaned pup – now and thereafter the only one to be seen – was wandering around the capture site call-howling, scenting tracks, and resting in a clearly distressed manner. Shortly afterward I flew 110 miles to the west to check on various other groups of wolves, including another that I expected Adams soon would be collaring (with an additional collar).

The helicopter and spotter Cubs were on their way west to work on these wolves as I started back east shortly before noon. I checked again on the Toklat wolves at 1:00 p.m.

(nine seen, still resting at the same location) and the Sanctuary pup at 1:15 p.m. (still by herself at the capture site, still obviously distressed and bewildered), and then departed the area for the day at 1:20 p.m. Based on the fact that the Toklat wolves were now outfitted with two strongly-transmitting collars (the new one, plus the alpha male's) and given that the collaring aircraft easily could have put another collar on Toklat before heading west but did not, I assumed that Adams was finished collaring this group until at least October.

Soon after I resumed flying the next morning, March 21, I acquired the signal of the Toklat alpha male's collar on mortality mode and tracked it to Healy at 11:35 a.m. I was surprised, to say the least. I wondered if for some reason he had gone outside the park boundary, 10-12 miles to the north (a trivial 2-3-hours down Savage River) and was shot by a snowmachiner or four-wheeler who then returned to Healy (10-12 miles to the east), where in the past I had radio-tracked other shot or trapped Denali wolves. The possibility of another collaring death did not enter my mind, because I had little reason to think there had been any additional Toklat collaring (per above).

After determining the approximate location of the collar in Healy (from the air), I tracked the alpha female's collar and found her together with seven others of the group, about two miles westward from her March 19 capture location. I observed the eight wolves closely from 11:50-12:35 as they turned southward up some 5,700-6,000-ft sheep ridges, behaving in a normal way. Meanwhile I could hear radio communications between the helicopter and one of the spotter Cubs as they conducted capture activities in the Castle Rocks area, some 90 miles westward.

I checked on the Sanctuary pup, the Lower Savage and Stampede wolves, then again on the Toklat alpha male's collar, which at 2:00 p.m. was still on mortality mode from the same location in Healy. I was not able to do an on-the-ground search in Healy until mid-morning the next day, March 22. By that time the collar was no longer transmitting from anywhere in the Healy area. I still suspected a shooting or trapping death and thought the shooter or trapper might have destroyed the collar overnight, specifically to avoid an obvious controversy. I drove to Denali Park headquarters to ask National Park Service officials what they knew and was referred to Research/Resources Chief, Gordon Olson, who was in Healy in a special meeting with his staff (Olson recently transferred to another NPS position, away from Alaska).

Olson had been told I was on my way with questions about the Toklat male. He was waiting outside the hotel meeting site when I arrived (it was clear that he did not want his 15-20+ staff members inside to hear our exchange). He told me that Adams told him the Toklat

male died after being captured for recollaring on the afternoon of March 20 but that he (Olson) didn't know any other details. I asked why I heard the Toklat collar transmitting from Healy, to which he responded he did not know. I asked if Adams had collared any other Toklat wolves on or since March 20 and he said no, that there was now only one Toklat collar, on the alpha female.

I told him I wanted to examine the carcasses of both the Toklat male and Sanctuary female, given that these were among my key study animals. He replied that both carcasses were flown to Fairbanks mid-late afternoon March 21, for necropsy by University of Alaska wildlife veterinarian Dr. John Blake (Blake has necropsied wolves for the National Park Service for many years, apparently under a contract arrangement}. I asked him if he would phone Blake right away to let him know I was on my way to Fairbanks (driving the 100+ miles from Healy) to see him and was authorized to examine the wolf carcasses. He agreed to do this. I departed immediately, at ~2:00 p.m.

Evaluation for and by the National Park Service

Blake was at his UAF campus office when I arrived from Healy at ~3:45 p.m., March 22. We had a relaxed, wide-ranging discussion for about an hour, during which he told me that:

- He had already necropsied and "disposed" of the Sanctuary female and Toklat male (though tissue analyses, etc. remained to be done), that only the skulls remained and these were unavailable for immediate inspection. I asked for a copy of his preliminary necropsy report. He said he would have to clear this with Adams, sometime over the next few days. He said he would mail me a copy if Adams approved (I never received anything);
- Both wolves appeared outwardly to be in good condition with "lots" of body fat, good teeth, good pelts, etc.;
- The Sanctuary female had a stomach "full of moose meat, about 1.5 kilos." However, Dennis Miller (the Cub pilot, who flew the wolves to Fairbanks for Adams on March 21) told him they had not seen a kill at the capture site;
- Both wolves appeared to be of prime age – young to middle-aged adults – and the Toklat male was a "big, nice-looking animal;"
- The Toklat male had early stages of degenerative disease (arthritis) in his joints, that this would not have caused any problems for him now but might have led to future problems;

- Neither of these wolves showed any darting abnormalities – i.e., each was struck by only one dart without any serious wounds or bleeding;
- The Sanctuary female showed indications of coming into her estrus cycle and probably would have bred in the presence of a mature male;
- Adams told him he used telazol to anesthetize these wolves;
- Telazol is a "fairly safe, benign drug" to use on wolves, even on 4-6-month-old pups;
- He sees no physiological problem in using telazol leading up to courtship and mating but would recommend against *any* drugging after implantation (about a week later) because of the danger of abortion and other problems;
- He could not eliminate an *overdose* of telazol as a cause of death and would be sending tissue samples "to Seattle" for evaluation of this and "related possibilities."
- Both wolves had enlarged spleens and deformities in their aortic valves but he could *not* say this was the cause of death.

Shortly after the wolf deaths, Denali National Park district ranger Tom Habecker conducted what the Park Service described as a routine "incident (law enforcement) investigation." This was followed by a combined scientific/administrative review through a committee appointed by the National Park Service, consisting of five Interior Department administrators and biologists, a state biologist, and a biologist with the Audubon Society (formerly a state biologist). On May 9, 2001, the National Park Service released the results of this committee's review together with a press release. The review, which relied heavily on both Habecker's incident investigation and Blake's necropsy report, concluded that:

- The heart valve defects Blake found in the Sanctuary female and Toklat male had predisposed these wolves to higher anesthetic risk and therefore were the most likely reason for their capture mortalities;
- The cause of death for the Otter wolf could not be determined because not enough of its carcass remained for necropsy;
- There had not been any mishandling of wolves, breaches of protocol, or errors of judgment during the capture activities;

- There were not likely to be any major biological consequences from these capture-related deaths, largely because they are small in number, especially relative to the frequency of natural deaths of wolves in Denali.

The review committee made several recommendations, primarily with regard to obtaining more information about the incidence of heart valve defects for wolves in Denali and surrounding areas.

I phoned Blake the same day, to discuss his findings. I suggested that heart valve incontinence, i.e., "heart murmur," is a condition often associated with inbreeding and told him about some of my observations of close, successful inbreeding among Denali wolves since 1966. I also mentioned another common, mildly-"deleterious" effect of inbreeding – kinked tails - that I have observed among Denali wolves. He agreed that the valve defects he found could be heritable and, in support, noted that he found the defect on the same cusp of the same valve in both necropsied wolves. I also told him I was diagnosed with a heart murmur as a child but have enjoyed a highly physical life without any treatment, including as a hockey player and cross-country ski racer. He agreed there was no a priori reason to assume that valve incontinence per se was a problem for the Sanctuary and Toklat wolves he examined.

I asked about indications of a parasitic disease he found in the Toklat male and he suggested this might have caused some diarrhea. I replied that I had not seen any hints of diarrhea or other problems during my close observations of this wolf March 13-20 and before. We agreed that both wolves were in good overall condition at the time of death, whatever the origin of their heart valve defects and despite the possibility of some diarrhea.

<u>Ensuing Sanctuary/Margaret and Toklat changes</u>

Sanctuary no longer exists as a resident Denali group. About half of the eastern park area that it used until March 2001 is now occupied by a small new group, "Margaret" (named after Mt. Margaret), that shifted and expanded its adjacent western territory. Toklat is still using its same area, with a new alpha male, but in late September 2001 lost its complete 2001 litter of four pups. I have not been able to monitor Otter Creek regularly since the loss of its radio collars in March-April 2001, though general observations of wolves and tracks in that area indicate there are likely still at least several wolves in this group.

1. Sanctuary/Margaret

As noted earlier, I observed the three Sanctuary 10-month-old pups together on March 17, 2001 near the site of their mother's capture death the day before. They were obviously bewildered and waiting for her to return (much call-howling, etc), and showed no indica-

tion of knowing what to do or where to go. By March 19 only two of the pups were present, and in all of my observations of the collared pup as of March 20 and thereafter she was alone. She continued to restrict her travels mostly to the east park boundary area between the capture site and park headquarters, spending much time near the Parks Highway, Alaska Railroad, and VillageView residential subdivision, outside as well as inside the park. 25 of my 28 March 16-July 10, 2001 radiolocations of her were in this area. She also traveled at least twice (2 locations) to the Cantwell area and once to Savage River in the park road corridor but showed little inclination to use most of the established Sanctuary territory. Essentially she ranged only within its eastern fringe.

By mid summer, now a yearling, she was shifting her activities 15-20 miles northward. All 10 of my July 22, 2001-March 4, 2002 radiolocations of her were in the Healy-lower Moody Creek-Jumbo Dome-Ferry area. Each time I saw her she was still alone but seemed to be in excellent condition. I observed her eating at several winter-killed moose carcasses, in two cases within a few hundred yards of occupied cabins but out of their view because of forest cover. On several other occasions I found her inside residential subdivisions in the Healy and Ferry areas, perhaps attracted by dogs (this was likely also the reason I found her near the dog kennels at Denali Park headquarters several times in late March and April 2001, shortly after she was orphaned seven miles southward).

On March 4, 2002, she was traveling eastward on the Ferry Trail, 10 miles north of Healy. Four days later, on March 8, she was 25 miles southward, back inside her natal territory - my first relocation of her in this area in more than seven months. She was only two miles from the location of her mother's March 16, 2001 radio-collaring death and within 200 feet of an active trap line just outside the east park boundary. I radio tracked her eight more times over the next seven days, as she ranged outside the boundary (and further east) between this area and the park entrance, 6-7 miles northward. During this interval she found the four Margaret wolves (below) while they, too, were outside the park. She followed them closely for at least a day, apparently trying to join them.

On March 15, exactly one year after she had been orphaned, I found her back at the March 8 location. This was the last I heard or saw her. There was an active trap line nearby and the trapper lives within a short walking distance. This is the same seasonal N PS employee whose trapping inroads since 1999 played a major role in reducing Sanctuary to a single adult and three dependent pups as of early 2001. On March 18-22 and 24, I searched for but did not hear her collar anywhere in the region (I also listened for it on 3/16, but high winds and turbulence prevented a good search). On March 26 I phoned Adams, who told me she

had been trapped and that the trapper had turned her collar into park headquarters sometime just before March 20. I told Adams where and when I last tracked her and asked if he would confirm that this was the same trapper. He refused and said, “You can figure that out for yourself.”

Why the orphaned Sanctuary female used so little of the established (Sanctuary) territory and departed for 7-8 of the subsequent 12 months is probably best explained by two factors, in addition to her status as a loner: (a) In eastern Denali, 10-month-olds are still heavily dependent on older wolves for territory knowledge, hunting expertise, and much else (Haber 1977), hence there had been little chance for her to develop a normal fidelity to the area; (b) The three Margaret wolves began occupying major portions of the Sanctuary territory within a few weeks of the adult female’s death and thus probably deterred this surviving pup from the area (on one occasion the three ate most of a winter-killed caribou she had found 2-3 days earlier, possibly chasing her away in the process).

As noted above, she seemed to be trying to join the Margaret wolves shortly after returning from her 7-8-month absence to the north. Had she lived, there were probably good odds of being accepted - as a young female – by the small, relatively new Margaret group. I saw little evidence of much hunting expertise on her part, even with caribou, which is usually the easiest ungulate species for young Denali wolves to capture and kill (Haber 1977). However, almost from the beginning she enjoyed a combination of skill and luck in finding winter-killed moose and caribou carcasses under natural circumstances (winter scavenging is of major importance to Denali and other wolves – Haber 1977). She remained in good condition and ranged over large areas. Finding other wolves, not food, seemed to be her biggest problem and probably best explains most of her dangerous ventures into residential subdivisions in the Denali-Healy-Ferry areas, where sled dogs are common.

Margaret consisted of three adult-sized wolves and three new pups in summer 2001. The adults were provisioning the pups at a rendezvous site in the northcentral portion of the Sanctuary vacancy as of early August, but one of the pups disappeared shortly thereafter. The two remaining pups began traveling with the three adults in late September, and another disappeared by October 20. The three adults and surviving pup were still together during my latest observations prior to this writing (mid-late March 2002). From March 30, 2001-March 24, 2002, I radio-located Margaret wolves 49 times. Most of these observations were within the northern half of the Sanctuary vacancy, with an apparent eastward and increasingly southward progression into remaining areas. Toklat also has made eastward forays deep into this vacancy – e.g., once to a point just southwest of park headquarters for 2-3

days in late November 2001, and once to the southern area (Riley Creek) for most of the latter half of March 2002.

Margaret is also beginning to venture unpredictably (7 of 49 locations) east and northeast (outside) of the park, as the predecessor Sanctuary, Headquarters, and Savage families did and Toklat does, into areas of high hunting-trapping danger where a protective buffer has long been advocated. Twice in March 2002, I observed forays of 3-5 miles - once for at least 2-3 days into the Moody Creek area (at one point only 3-4 miles outside Healy), and once shortly afterward for three days to the north side of the Yanert valley and Montana Creek.

2. Toklat

Toklat is the group I study most intensively, via aerial radio tracking year-round and ground observation from late May-September.

Two adult-sized newcomers – both males – appeared in the Toklat territory in late April 2001 and by mid June had almost fully integrated with the Toklat alpha female, at least four of her 7-8 surviving offspring from the previous three years, and the four new pups (born in late May). The newcomers were already showing as much care and affection for the new pups as were the pups' mother and older sibs, all of which she had produced with the alpha male who died in March. Nor was there any obvious difference between the newcomers' behavior toward these pups and the dead alpha male's behavior toward his previous litters.

However, it seemed to take most of the summer for the alpha female to fully accept the newcomers. Initially she kept them 25-30 feet from the pups, and remained "standoffish" after that, but never did I see her try to run them off, nor did I see any clear-cut dominance in either direction. Her offspring (all ages) accepted the newcomers almost from the beginning and in general responded submissively to their assertive albeit friendly behavior. I am virtually certain that it was some of the older young who met the newcomers and first brought them home to the den and their mother. I would not have expected this to happen with her mate still alive.

Both newcomers wore ear tags of almost identical appearance, the color, size, and shape of which suggested they most likely came from the Fortymile region, 200 miles to the northeast. On September 29, Adams captured one of them – the new alpha male - for radio collaring, via helicopter darting. The number on this wolf's ear tag confirmed that he (and likely his companion) had come from the "Fortymile" (upper Chena R.) region. He was captured there by state biologists on April 5, 2001 and flown about 300 miles westward to the Melozitna River, where he was released as part of the state's Fortymile wolf control program.

He appeared 200 miles southeast in Toklat's area less than a month later. His companion was likely of the same origin (Fortymile control program). They exhibit a noticeably close, friendly bond, rather like older-younger brothers.

The newcomers have continued to lead and otherwise assert themselves in most of the winter hunting routines, albeit with the one clearly dominant and more assertive than the other. Only four of the female's 7-8 older offspring were still with the group as of late summer (the others likely dispersed in normal fashion). These seven adults were together – acting cooperatively and affectionately - in all of my subsequent observations prior to an apparently accidental separation of the alpha female and two older offspring from the others on March 22, 2002. They were still separated on March 30, my last information prior to this writing.

The annual courtship and mating activities seemed to begin normally during the first few days of March, at about the time the seven went to last year's natal den and cleaned it out. Poor flying conditions (high winds) made it difficult to monitor sexual activities closely over the next 7-10 days, but on March 13 the seven returned to the natal den and there was intense sexual activity under ideal observational conditions.

Two females were in full estrus – the alpha female and one of her daughters – and the newcomer alpha male tied with both of them. Both solicited sexual attention from the two newcomer males with repeated, obvious advances. No other wolves were involved (they remained nearby but mostly out of view at scattered locations). The alpha female solicited from the non-alpha newcomer but could get him only to mount briefly, without a copulatory tie. She continued to solicit from him for most of two hours, by cuddling with him and even squatting over his head, but essentially all he did was chew on an old bone and sleep.

Meanwhile her daughter solicited from the alpha newcomer. He responded immediately, first with 2-3 mounts and then a copulatory tie that lasted about 10 minutes. Afterward he slept for about two hours, and then walked over to the alpha female who was now lying by herself, 50 feet from the other newcomer who was still chewing on the bone. He mounted her while she remained lying down but with her posterior raised somewhat and tail to the side. They locked fairly quickly and remained in this tie for 12-13 minutes. Her daughter stimulated him orally throughout much of the tie and was clearly in a heightened state of excitement herself. All three rested together afterward, while the nearby non-alpha newcomer continued to chew on the old bone, still not showing any interest.

One of the more intriguing aspects of this sexual activity was the absence of any male-male or female-female aggressive behavior, indeed the generally cooperative nature of the interactions. This is in contrast to most of my observations from earlier years, especially

involving the well-established Savage family lineage (Haber 1977). It will be important to determine if two litters emerge in early June. Multiple simultaneous litters are nothing new for Toklat. There have been multiple (2-4) litters in 11 of the 31 years I could make this determination, as opposed, for example, to one of 12 for the neighboring (former) Savage family. However, this year a multiple would come the closest to having a known polygamous origin, if "polygamy" is the best way to think about a multiple mating involving a cooperative mother-daughter linkage.

3. Sudden disappearance of the Toklat pups

In late August the Toklat wolves moved their four pups from the natal den and split them up. Two of the pups were subsequently provisioned through at least September 22 at a rendezvous site 10 miles to the southwest, primarily by the alpha female and several older offspring. The other two pups apparently were provisioned at one or more sites within about two miles northward and westward of the natal den during the same period, largely by the two newcomer males. Both sets of pups were beginning to travel with adults at least periodically as of mid-late September – the first two with the mother and up to four of her older offspring, the second two with the newcomers and one of the older offspring. All four of the pups appeared to be in good condition but were somewhat smaller than usual, probably because they were born late (1-2 week annual variation is not uncommon [Haber 1977], nor are variations among groups during the same summer). The pups were still being attended in two groups in about the same way on September 26 when I last observed them.

On September 29 (and apparently September 28) Adams saw all 11 of the Toklat wolves together (the 2 newcomer males, alpha female, four older offspring, and four 2001 pups). He had been in Denali for several days with a helicopter and two Super Cubs to do more radio collaring. I was under the mistaken impression that he was there to do caribou composition surveys and related work, so I left Denali on September 28 for several days of aerial radio tracking in the Fortymile region (I have been studying 12-18 additional groups of wolves there since 1993).

Not until several days later did I learn that Adams had been in Denali primarily to radio collar wolves, including one of the Toklat newcomers on September 29. The next observation of Toklat wolves by either Adams/NPS or me was by me on October 20, the first day of my next round of aerial radio tracking (10/20-29/01). Only the seven adults were present, and only these seven have been seen in numerous observations by Adams/NPS and me since then (including on my last complete count prior to this writing, March 24, 2002).

Various natural possibilities could explain the sudden disappearance of an entire litter. However, given the (typical) quality care the Toklat pups were receiving and their good condition, any natural explanation most likely involved a quirk. I phoned Adams on October 30 and November 15, 2001 to ask him what he knew about this disappearance and the possible role of his September 29 helicopter darting of the newcomer. We had previously discussed some details of the September capture during an October 9 phone conversation, before either of us knew the pups had disappeared.

Adams said he observed the seven Toklat adults and four pups traveling together on September 28 and noted that, "The pups were having a difficult time keeping up – they were small." All 11 of the wolves were still together the next day, "in the upper Teklanika area, almost into the Sanctuary." He approached the group in his helicopter and "singled out the black male," apparently chasing him a substantial distance from the others before successfully darting him and attaching a radio collar. He could see that the six other adults were still together as the chase began but did not attempt to observe them afterward.

In response to my questions about what the pups did, he again indicated he didn't observe many details but that "[the pups] may have run around some" (when the helicopter approached). He or an assistant returned the next day, apparently in a Super Cub. He obtained a radiolocation for the Toklat female in the same general area where the 11 had been the previous day but was unable to actually see her or any other wolves, due to "heavy brush." The newly collared male was still at a different location, apparently near the capture point. Bad weather precluded any subsequent observations by Adams or NPS prior to my observations on October 20-29.

I asked Adams what he thought happened to the pups, to which he answered, "Who knows what happened – animals die out there." He again emphasized that the pups were smaller than usual although never directly expressed the view that this was a factor. I told him I agreed they were small but that annual and within-summer (between-group) variations were not unusual. I emphasized that my ground and aerial observations during the summer and fall indicated the pups were being provisioned well and that they were in good condition as of late September.

Review

Radio telemetry has added greatly to biologists' ability to collect important information about wildlife, including wolves in Denali. But like most useful tools, telemetry can also be misused. Here I will focus on problems that can arise during radio collaring. I have never

seen any indication that the radio collars themselves bother wolves or impede their natural activities. However, the two major steps of the collaring process – helicopter capture and drugging – can lead to injury, death, and other serious problems if not undertaken with extreme care and good judgment. Wolves generally ignore low-flying fixed wing aircraft but commonly flee an approaching helicopter in panic. Individuals, especially young pups, can become separated and perhaps lost or injured, and important activities (e.g., courtship and mating) can be disrupted. Drugging can lead to dart injuries, death, or other problems from accidental overdoses, use of the wrong drug, and effects on pregnancy or other physiological conditions. In certain cases it can also leave the wolves temporarily much more vulnerable to human hunters and other predators.

What caused the March 2001 wolf deaths?

I agree with NPS that not much can be concluded about the Otter Creek wolf death because of the virtual absence of remains to examine and the possibility of misinterpretations from such scant remains. My last observations of the Otter wolves prior to the March 2001 death were in January. There were still 10 wolves in the group at that time. All 10 were behaving normally and seemed to be in good condition.

NPS has emphasized heart valve problems as a primary factor in the Sanctuary (adult female) and Toklat (alpha male) deaths, via predisposition to higher anesthetic risk. But there is a simpler, more likely explanation: Adams may have unknowingly shot these wolves with similar-looking darts meant for moose or caribou. The moose/caribou darts probably contained the immobilizing drug, carfentanil citrate, instead of the canid anesthetic, telazol. Carfentanil would be fatal to a wolf in most cases not only because it is a stronger drug but also because it requires a reversal agent (naltrexone hydrochloride). Telazol does not require a reversal agent, so if a biologist thinks he has just darted a wolf with this drug he will not administer the reversal agent afterward, and whatever chance the wolf may have had of surviving the carfentanil injection is gone.

I do extensive radio tracking but not any darting. Based on what other biologists with extensive wolf and ungulate darting experience have told me, the similar appearance of these darts would make it easy to mistake one for the other. Typically the only major outward difference in appearance is in the coloration of a tail stabilizer. Both kinds of darts are loaded and can be fired the same way from the same dart gun. It doesn't take much imagination to visualize a biologist grabbing the wrong dart from a container holding both kinds, or grabbing the wrong gun if two are used, while in hot pursuit of a wolf 50 feet below as he is leaning

(strapped) half outside the door-less helicopter in the open-air blast with cold fingers and perhaps partially fogged glasses.

The fact that Adams was darting wolves, moose, and caribou interchangeably throughout the March 2001 expedition – including on the same flights – confirms that he carried both kinds of darts and/or dart guns. The odds of making mistakes increased even further when he prepared at least some of the darts just prior to capture, while inside the helicopter or during a brief landing. Loading darts (with drugs) in a warm room under carefully controlled, focused, unstressed conditions prior to the day's flying is one thing, doing it hurriedly during a cold, perhaps windy helicopter stop is quite another. Again, it doesn't take much imagination to visualize resulting problems, in dosages as well as the kinds of drugs loaded into the darts.

The heart valve explanation remains a possibility, but only a highly speculative one that even the veterinarian who did the necropsies did not seem to advance initially. No one has shown any connection between the observed heart valve irregularities and drug effects in these two prime-age wolves that were in good overall condition and had been behaving normally right up to the time of death. Occam's Razor dictates the simplest explanation when there is such ambiguity, and it seems clear what the simplest explanation is in this case.

I phoned Blake (who did the necropsies) on October 9, 2001 and once again 1-2 months later to ask if any Sanctuary or Toklat tissue samples had been tested for carfentanil. He answered no, said no test was planned, and confirmed that any such test would have to be specific for this drug or whatever other drug was suspected. He indicated surprise when I told him Adams had been darting moose and caribou together with wolves. He said he had assumed that only wolves were being handled. He agreed that a telazol-carfentanil mix-up would almost certainly be fatal for a wolf. He added that he had not heard anyone else mention this possibility and did not think the NPS review committee had considered it.

<u>What happened to the 2001 Toklat pups</u>?

My extensive June-September observations of the Toklat pups, dating back to their first emergence from the natal den in early June, indicated they were in good condition. Neither Adams nor anyone else (other than the NPS Denali research coordinator who accompanied me on a trip to the natal den in June) spent more than a few minutes, total, observing these pups. Thus there is no basis for any inferences about poor condition as a factor in their disappearance (this includes an arbitrary comment in a recent Alaska Wildlife Alliance newsletter, that "nutritional stress may have been a factor").

As indicated earlier, if the pups' disappearance between September 29 and October 20 was due to a natural cause it was almost certainly something unusual other than food shortage. The pups were somewhat small for four months of age, but that was probably due to a late birth, not anything related to food intake or overall health. Birth dates are next to impossible to determine because the pups are typically born inside a den and do not emerge for the first time until several weeks later. However, the copulatory ties that I observed between the Toklat alpha pair in 2001 were on March 13, which falls near the "late" end of the March 3-14 range I observed for Savage and Toklat alpha pairs in earlier years (Haber 1977). The gestation period for wolves is 63 days.

Adams' September 28-29 aerial observations of the pups struggling somewhat to keep up with the traveling adults are consistent with my observations on September 26. But this did not mean the pups were destined to be left behind on their own. The adults almost certainly would have parked them at a rendezvous site and continued provisioning them there and perhaps at other sites for another 1-2 months (for example as Toklat and Sanctuary did in 1998 and 1999, respectively), until later "test runs" indicated they could travel normally. Easing the pups this way into the continuous travel routine of the winter months is nothing unusual for Denali wolves (Haber 1977).

A more likely explanation is that the pups scattered in panic and became lost when Adams' helicopter descended on the group for his September 29 radio collaring capture of the alpha male. The response by pups of this age would be extreme. This was illustrated under much less traumatic circumstances only a few weeks earlier when two of the pups (the only two that were present) began to flee from several parked shuttle buses that the adults were ignoring. The results were potentially much more serious for the pups on September 29 because the helicopter probably caused adults to scatter as well. I can easily visualize the four pups panicking and running off in different directions amidst the noise and confusion, and simply getting lost in brush and/or rugged, rocky terrain. At that age they could not survive on their own for long.

Adults and older pups eventually find each other following most separations, whether they become separated during a helicopter capture, pursuit of prey, or for some other reason. However, "eventually" sometimes means days or weeks, which would be much more serious for a nearly helpless four-month-old pup on its own. Approaching pups of that age with a helicopter might not guarantee a problem, but it is a virtual invitation for one. Collaring the Toklat newcomer could have waited 2-3 months or more, until the risks of separation for

the pups would have been much lower.

National Park Service burden of proof

Although I cannot be certain about what caused the deaths of the Toklat alpha male and Sanctuary female in March 2001 or what happened to the Toklat pups 6-7 months later, the burden of proof is not on me. It is not up to me to prove beyond a doubt that NPS did something detrimental to these wolves (however inadvertent). It is up to NPS to ensure that any radio collaring activities involving Denali (or other park) wolves are carried out in a way that leaves no questions about the wolves' well being or other potential impacts. Major questions remain about the March and September 2001 collaring activities in particular. The bottom line is that it should be possible to exclude human causes in explaining these deaths but because of the lingering questions is not, and that is reason enough to hold NPS accountable.

Related collaring decisions

Safe radio collaring requires much more than just the proper drugs and dosages. Good judgment must be exercised in related decisions. Approaching four-month-old wolf pups with a helicopter to collar the new Toklat alpha male, as described above, was not good judgment. Similar lapses accompanied the March 2001 collaring deaths and have been commonplace during wolf radio collaring activities in Denali (and elsewhere) for years.

Adams knew beforehand that the Sanctuary family had been reduced to a single adult and her three surviving 10-month-old pups. Essentially the fate of this family lineage depended on her. Given the risks inherent to radio collaring even when done properly, Adams should have waited until the next winter (2001-02) to change her collar, when her young would have had much better knowledge of the established territory and better odds of surviving in general. A mishap in collaring her at that time would have been much less consequential for the young and thus the survival of the family lineage. Denali wolves acquire major expertise in their territorial knowledge and overall hunting skills between 10 months of age and sexual maturity at 22 months (Haber 1977).

It is a general rule of thumb that wolf radio collars should be replaced at least once every three years, due primarily to battery life. The Sanctuary female's collar had reached this age and was noticeably weakening in signal strength. Nevertheless I was not yet having major problems radio tracking her with this collar, even in the rugged mountains of her territory. In all likelihood her collar still would have been useable into the next winter and together with the new collar Adams placed on one of her 10-month-olds should have provided adequate telemetry contact until she could be recollared with less risk. The rule of thumb about battery life should not have overridden these considerations.

The Sanctuary wolves were resting near the edge of a steep, rocky precipice at the time of darting. Adams planned his helicopter approach so as to surprise the wolves from the steep east side of the bluff and cause them to run westward, across the open terrain of a gently sloping plateau. Obviously this was a safer, easier place to do the darting.

However, wolves are not always predictable, and at least one of the pups ran into the rocks instead of across the plateau with the others. There were no known consequences in this case, but it is easy to visualize a different outcome for young wolves in such a treacherous spot. Wolves routinely chase sheep though all kinds of treacherous mountain terrain in Denali and sometimes fall over steep edges. But this is not the same as fleeing in panic from a helicopter, especially upon being abruptly surprised from sleep. It was another judgment call that should have given more weight to the thin thread this family's survival was hanging on at the time. It would have been prudent to postpone the collaring perhaps for another day or two, until the Sanctuary wolves were in less risky terrain.

Necropsy revealed about 1.5 kg of moose meat in the adult female's stomach. This indicates the Sanctuary wolves had probably eaten well a short time earlier, though neither Adams nor I saw evidence of a kill or winter kill at this location. Causing a wolf to run hard on a full stomach is another known risk, among other reasons because of the danger of choking on its own regurgitate. Good judgment in collaring includes monitoring wolves closely enough to be sure they have not eaten any large meals for at least 1-2 days beforehand.

Collaring three Toklat wolves in March 2001 resulted in one death but easily could have meant other problems, if not another death, likewise because of questionable judgment. [I did not know, until Adams told me in June, that he collared a yearling female together with the alpha male on March 20, while I was absent. This female was not with the eight other Toklat survivors when I checked them closely the next day or in any of my subsequent observations through May 2. Nor have I seen or heard any indication of her presence with the core Toklat group since then, except possibly once in June. Ten Toklat wolves were present when collaring (of the alpha female) began on March 19].

One of the main reasons why I was not present when Adams recollared the Toklat alpha male on March 20 was that his three-year-old collar was still transmitting a strong, reliable signal. There was not much difference in strength and clarity between his collar and the new collar Adams put on the alpha female the day before, for example. Her new collar meant there were once again two strong collars and thus little chance of losing telemetry contact. I concluded there was no need to replace the male's collar and assumed this was also obvious to Adams.

So perhaps the most basic observation to be made about the Toklat male's recollaring death is that better judgment would have delayed this collaring, probably until the following winter. This again makes an important point about the three-year recollaring rule of thumb: Maintaining a schedule and replacing all the collars of a group at the same time are understandable objectives, but they do not take precedence over the safety advantage of leaving well-enough alone when an existing collar is still performing strongly. Given the risks inherent to collaring, "only when necessary" is a better rule of thumb.

The courtship and mating activities that extend (in Denali) over much of the first half of March, and sometimes begin in late February, constitute one of the most important behavioral events of the year for wolves, if not the most important. This behavior is described in detail for Denali wolves in Chapter 8 and related appendices of Haber (1977), the most complete record of courtship and mating published for wolves in the wild (see also the Toklat summary for 2002, in "Ensuing Sanctuary/Margaret and Toklat changes," this report). It should be clear from the intense nature of this behavior how vulnerable it is to disruption, let alone how important it is. It is also well known that telazol and other anesthetics can lead to abortion or resorption in pregnant canids. The manufacturer's instructions provided with telazol specifically recommend against using it during any stage of pregnancy for these reasons and because it can lead to respiratory problems for newborn pups. John Blake, the veterinarian who necropsied the Denali wolves for Adams and NPS, emphasized to me the importance of not darting female wolves at least following implantation.

Yet, almost every year, including in 2001, major NPS-sponsored wolf radio collaring activities using helicopter pursuit and darting with telazol and perhaps other anesthetics have proceeded during and after courtship and mating. It seems apparent that in most cases the biologists doing the collaring were not even aware that courtship and mating was or had been underway. They spend little time – commonly none at all – observing this or other behavior. Not once did I hear Adams and his crew mention anything about Toklat's courtship and mating activities in 2001, for example, even though they were underway at the time. His decisions about when and where to collar these wolves were determined primarily by logistical considerations, whether the wolves were in accessible areas for darting, and – it seemed at least for the alpha female on March 19 – whether he thought I was present. It will remain an open question – where there should not be a question - as to how many of the unexplained reproductive failures observed in Denali since 1985 were caused by radio collaring and how many of the successes were close calls.

The Toklat wolves were collared 5-6 miles east of their established territory, as they were progressing eastward through an area being used by the Margaret and (earlier) Sanctuary wolves. Wolves embark on extraterritorial forays for various reasons (Haber 1977; Mech et al 1998). They are probably at higher risk while on these forays, for example from attack by resident wolves and shooting or trapping by people. The lingering effects of drugging together with any subsequent scattering and separation are among the ways collaring could exacerbate these risks. Better familiarity with the "home turf" is a well-known survival advantage of territoriality in general. Thus another way to minimize the risks of collaring is to avoid doing it when a group of wolves is well outside its territory. Again, there were no indications from Adams' radio conversations with his crew just prior to the Toklat collaring on March 19 that he weighed these considerations.

The previous collaring of Toklat wolves, on March 21, 1998, illustrates that this kind of carelessness and poor judgment is nothing new. Toklat had declined to three wolves at the time. I radio-tracked and observed the three from 7:42-7:52 a.m. (3/21/98), as they ate at a half-consumed adult moose winter kill carcass about four miles outside the north park boundary, just south of the Stampede Trail on the forested east side of the Teklanika valley. I radio-tracked other wolves for a couple of hours, then at 10:00 a.m. began monitoring Adams and his crew as they collared the Toklat wolves at the above location. Adams was in a Bell 206B Jet Ranger helicopter with pilot Paul Walters and an NPS Denali biologist. One of the accompanying spotter Super Cubs was piloted by Dennis Miller, who was accompanied by Adams' assistant in the rear seat. The other was piloted by Don Glaser accompanied by a second NPS Denali biologist.

It was apparent to at least two of these three aircraft that the three Toklat wolves were eating at a moose carcass and already had full stomachs. Nonetheless, the plan was for Adams to use the helicopter to "drive" the wolves off the carcass, out of the forest, and into open tundra to the east, where he could dart them. As this maneuver commenced at 10:15 a.m., Miller, circling low overhead, noted the wolves' satiated condition to Adams, on his radio: "They've got a gut wad – they're not interested in moving very fast." One of the three wolves then ran off into the trees and disappeared. The other two – the present alpha female and her mate, i.e., the alpha male who died during recollaring in March 2001 – remained together as they fled according to the plan, eastward into the open tundra. At 10:27 a.m., Adams darted both in rapid succession from overhead in the helicopter, with the male running just behind the female. At 10:40 a.m., both were noticeably succumbing to the drugs and shortly thereafter fell together (e.g., Miller: "They're staggering pretty good now, right together,

touching each other in the wide open [tundra] – right next to each other."). Adams then landed, replaced the female's collar, and put a collar on the male.

The two wore these collars until replacement and death in March 2001. Unlike the case in 2001, in 1998 both seemed to recover normally after collaring. When I next checked them, on March 23, 1998, they were back at the nearby (now completely-eaten) moose carcass, resting with a third wolf - probably the one initially with them on March 21. By April 5 and thereafter the third wolf was no longer present.

Less than an hour and a half after collaring the Toklat pair on March 21, 1998 – while the pair was still recovering at the darting location, Adams and crew flew to a collared group of four wolves 10 miles to the north-northwest, to add a collar. These four likewise were eating at a kill, from which Adams chased them and collared one, again without any obvious problems. About an hour after that, Adams and crew flew to a collared pair of wolves six miles west of the Toklat location and replaced both collars without incident. These two were not at a kill.

The uneventful outcome of the March 1998 Toklat collaring was little more than luck. It was a pleasant Saturday in March within easy viewing distance across open terrain from the heavily traveled Stampede Trail, at a location outside the established Toklat territory and outside the park where it was legal for anyone with a trapping license to shoot an unlimited number of wolves or with a hunting license up to five, on sight. The helicopter and Super Cubs could have quickly drawn attention to the two Toklat wolves had anyone been passing by on the Trail at that time (I saw a snowmachiner and 2 dog mushers on my previous visit, 3 days earlier), and the two wolves were left to recover on their own - drugged and then groggy – at that exceptionally dangerous location. They were intentionally chased there, on full stomachs, with little if any consideration of these risks, solely because it was a good location for darting. They were chased, darted, and drugged without any obvious awareness or concern about the female's pregnancy and implantation. Nor did it seem to matter that this world-famous, highly valued family lineage was at a vulnerable turning point in its long history, with only a few wolves left.

In short, Denali wolves have been subjected to an ongoing crapshoot. Perhaps the only surprise about the 2001 problems should be that much more of the same had not already become apparent.

A final point should be made about quality control. It is usually obvious soon after placement on wolves (and other species) that some radio collars are not as good as others, in terms of signal strength and clarity. Given the inherent risks of capturing and collaring a wolf,

only the highest quality collars should be used, to help maximize the interval between capture and recaptures. Currently there is little if any prior field-testing of collars – they are outfitted virtually from the box. When I asked Adams if he does any field-testing he answered, "They are tested at the factory." For example, it has been obvious to me and my pilots since we first tracked the Toklat alpha male's new collar in October 2001 that it does not transmit as strongly and clearly as it should – not even as well as the three-year-old collar the previous alpha male was wearing in March 2001.

A simple one-hour or less field test could ensure better quality control. Prior to the day's collaring activities, prospective collars (and some extras) should be activated and left at the park airstrip. The spotter Cubs would then fly 8-10 miles away and track these signals back to the airstrip. Only the collars that the pilots and observers agreed transmitted with excellent strength and clarity would be used.

National Park Service investigation and review

NPS's investigation and review of the March 2001 wolf radio collaring deaths itself leaves serious concerns. The questions and concerns discussed in the foregoing sections arise in a fairly obvious, logical, straightforward way; they hardly involve anything exotic. Yet there is no indication in the NPS press releases or reports that NPS or its expert panel worried about or even considered them.

NPS began with a "standard" incident investigation, conducted by Denali north district ranger, Tom Habecker. Habecker's investigative report and Blake's necropsy report were central to the subsequent technical review by NPS and its expert panel. It is standard in most investigations to seek out and interview witnesses. My pilot and I were witnesses to much of what happened, indeed the only witnesses not associated with the federal employees and contractors who did the collaring. At no time did Habecker or anyone else from NPS ask in any formal way about what we had seen and heard, even though our on-the-scene presence was well known to NPS and was being reported prominently in the media. In fairness to acting superintendent Ralph Tingey, I did tell him I would be preparing a report, and he encouraged me to do so. It has taken me longer to get at this report than I had anticipated. Nevertheless I would not have hesitated to answer any questions from NPS investigators and the expert panel beforehand, had I been asked. The completion date of my review should have been largely irrelevant to their review. It seems likely that even just the highlights of the information I am now providing would have made an important difference to NPS's conclusions.

The carcasses of the Sanctuary female and Toklat male were of central importance as key pieces of evidence. For me to have been able to examine and photograph them intact

as well as during necropsy also would have been of major research value, in view of the length and intensity of my field studies of these (and predecessor) family lineages. NPS handled the two carcasses as anything but key pieces of evidence or in recognition of their full research value. There was no attempt to secure them in cold storage pending further deliberation, which would have been simple to do. Both were necropsied and summarily disposed of on March 21 or 22, less than a week after the female died and only 1-2 days after the male died. I did not know the carcasses had been sent to Fairbanks for necropsy until (former) Denali research/resources chief Gordon Olson told me just before 2 p.m., March 22, as we met in Healy. I immediately asked him to phone Blake to let him know I wanted to see them and would meet him at his UAF office within two hours. A few minutes later I was on my way, driving the 110 miles from Healy. I arrived at Blake's office at 3:45 p.m., but he told me it was too late, the carcasses were already gone.

Finally, NPS investigation and review should have been triggered by the *first* discovery in the March 2001 sequence of collaring deaths, i.e., of the Sanctuary female on early March 17. Pending an understanding of the cause and remedial measures, the first step in this response should have been to immediately suspend all further capture and collaring activities, as of early March 17. The capturing and collaring did not stop until four days later, on the afternoon of March 21. It continued even after discovery of the dead Otter wolf on March 17 - only a few hours after discovery of the dead Sanctuary female - and of the dead Toklat male on March 20 or early 21. From what I observed and the radio communications I heard – and the March 22 ending date Adams provided to me in a phone conversation before his March 2001 field work began, it seems clear that the capturing and collaring ended when it did primarily because most if not all of the planned work had been completed, not because of the wolf deaths.

Biological and other consequences

In their March-May 2001 press releases, review, and comments to reporters, NPS and Adams emphasized that only eight (2%) of the 327wolves that had been radio-collared in Denali through March 2001 were known to have died capture-related deaths. However, there is much more to consider than simple head counts in determining impacts, especially when the deaths include alpha and other key individuals.

It would be difficult to imagine many biological consequences of greater significance than have followed the recent Sanctuary and Toklat losses. Sanctuary was terminated as a family lineage and is being replaced by a different lineage. This is the third human-related termination of a family lineage in that (eastern) wolf area of Denali since 1982, where it is

likely there would otherwise be persistence (e.g., the Savage family lineage, which was already well established when I began studying it in 1966, lasted until winter 1982-83). Within a period of only 6-7 months in 2001, the neighboring 62-year-old or older Toklat family lineage sustained losses of its alpha male, his last genetic contribution to the lineage - i.e., the four 2001 pups, and the reformulating group's demanding four-month time and energy investment toward raising these pups.

The latest (Sanctuary to Margaret) eastern-park turnover and especially the appearance of the Toklat newcomers begin interesting new biological chapters that I will continue to follow closely. Nonetheless in both cases these amount to human-caused experiments that never should have happened, especially in a national park. Both cut short much more interesting and biologically valuable streams of information. For example, the Toklat alpha male and female (who were most likely siblings) constituted one of the closest, most efficient pair bonds I have seen in 36 years of research. I had monitored this pair closely since its first litter in 1998. It would have been a major contribution to the understanding of social organization in general to be able to determine its duration and long-term reproductive success under natural conditions.

Similarly, despite longstanding assumptions in biology that virtually all inbreeding is bad, there is evidence to the contrary for some types of social organization and in other circumstances. Close (e.g., father-daughter) inbreeding takes place successfully among Denali wolves (Haber 1977). But human-caused disruption has precluded answering key questions about its prevalence and long term success under natural conditions. The established Toklat alpha female and one of her daughters (from the former alpha male) both came into full estrus this year (March 2002). They cooperated closely as the new alpha male engaged in normal copulatory ties with both of them. Had the former alpha male been present instead, there is a good chance this would have provided an ideal opportunity to observe and measure the long-term success of another father-daughter mating.

There is no shortage of information about the biology of exploited wolf populations and unnaturally disrupted and reformulated family lineages. There is pitifully little information about what happens under natural circumstances, especially over long periods of time, despite the fundamental importance of this kind of information from both basic and applied standpoints (Haber 1996).

NPS biologists and managers have also tried to minimize visitor-viewing consequences. They point to the rapid recolonization of at least part of the Sanctuary vacancy by the neighboring Margaret wolves as the latest illustration of why they do not feel there is a

problem. But it may not be that simple for the many thousands of people who come to Denali each summer hoping to see wolves in the wild.

Wolves typically recolonize and habituate quickly, but they do not necessarily re-establish the specific denning, hunting, and other learned traditions of the previous wolves, or if they do, this may not happen for years or decades. It is these kinds of details that ultimately determine many of the visitor-viewing as well as biological consequences when one group replaces another. For example, although it took only a few months for Sanctuary to recolonize the vacancy resulting from Headquarters' trapping demise in 1995, it was not until late summer-fall 1999 that it began using a well-established Headquarters (and in earlier years, Savage) den and rendezvous site complex within the park road corridor.

Only then did Sanctuary begin providing a semblance of the spectacular summer wolf-viewing opportunities that had been commonplace in this area of the park, right from the road, at intervals dating back at least to the mid 1960s (opportunities that equaled or surpassed the more publicized opportunities of the last two decades to view Toklat wolves). Now Margaret 's specific summer patterns of use of this area are beginning to develop. The three adults and their pups used the aforementioned rendezvous site-den area during a portion of August 2001 but then moved westward and did not provide anything close to the previous viewing opportunities.

Most of the hundreds of thousands of visitors who came to Denali from 1995 through 1998 knew nothing about the 1995 loss of Headquarters and how this had likely deprived them of opportunities to see wolves fairly easily along the unrestricted first 15 miles of the park road, where everyone is allowed to drive (as opposed to the rest of the road, where most private vehicles are banned and the only alternative is to board shuttle buses). It remains to be seen how many more visitors will lose this opportunity without even knowing it, as we await the outcome of the latest turnover in the easternmost wolf area.

Recommendations

NPS's management actions in Denali National Park and Preserve are guided by an Alaska National Interest Lands Conservation Act (ANILCA)-mandated General Management Plan (GMP). The Denali GMP was developed over a period of several years, revised and fine-tuned through extensive public hearings and written comment, and signed in 1986 by the superintendent, NPS Alaska regional director, NPS Director, and Assistant Secretary of the Interior for Fish and Wildlife and Parks. Among much else, it emphasizes the importance of

individual family lineages of wolves in Denali, particularly the major eastern groups, and the need to protect them outside as well as inside the park.

Since the early 1990s, NPS has essentially ignored this provision of the GMP and has gone out of its way to do just the opposite – i.e., argue that only area-wide numbers ("the population") matter, not the integrity or survival of family lineages ("packs") or individuals. NPS has spearheaded much of the opposition to creation of a buffer zone that would help to protect Toklat, Sanctuary/Margaret, and other Denali groups during their unpredictable forays outside the park. It has vigorously opposed all attempts even to protect wolves inside areas of the park where currently it is lawful for so-called subsistence hunters to shoot up to 10 wolves apiece and for trappers to take unlimited numbers.

I have countered the biological underpinnings of NPS's thinking in detail, for example in Haber (1996, 1998, 1999, 2000), and have often reminded NPS of its statutory and regulatory obligations under the ANILCA-mandated GMP. However, even if NPS's biological thinking *was* beyond question and even if there were no GMP, NPS still would not be entitled – per other statutes and regulations – to jeopardize the survival of individual wolves or integrity of family lineages by allowing anything less than the most stringent procedures in the way wolves are radio collared or otherwise handled during research and management activities. Regardless of whatever views NPS now chooses to express about its GMP and the biology of wolves, none of this provides a license for careless handling of park wolves.

Thus, my most basic recommendation is that NPS must put aside its own and Adams' views about the expendability of individual wolves and family lineages and ensure much more care and oversight in the way they (and other species) are captured and radio collared. More specifically:

1. Shortly before each proposed new round of radio collaring, NPS should convene a meeting to include *all* scientists currently doing field research on the animals and groups involved, to provide better awareness of any new or developing problems and to ensure that there is a need for the proposed collaring (e.g., vs. simply adhering to a 3-year replacement schedule). Such a meeting could have prevented the capture and recollaring of the Sanctuary female in March 2001, for example, by calling wider attention to her critical importance to the survival of the Sanctuary family lineage at that time.

2. Wolf captures and collaring should be undertaken only on separate, dedicated helicopter flights, and only after field-testing of the collars. No ungulate, bear, or other darts or drugs should be permitted aboard the helicopter on these missions. There should not be any field preparation of darts or drugs; all of this should be completed beforehand under

carefully controlled conditions. A qualified veterinarian should be present in the helicopter to share responsibility for ensuring that the proper drugs and dosages are administered, that related standards are met, and to monitor recovery.

3. Wolf captures and collaring should be undertaken only during November, December, January, and the first three weeks of February. Late February-mid March should be excluded so as not to disrupt sexual activities, mid March-mid May due to the danger of triggering abortions and other pregnancy complications, and mid May-October to avoid causing separations of dependent pups and because of the greater danger of losing darted wolves in brush and forest cover.

4. Wolf captures and collaring should not be attempted – even in November-February – where terrain or vegetation conditions create a substantial likelihood that darted animals will escape or sustain injuries while fleeing (e.g., near a steep bluff).

5. Wolf captures and collaring should not be attempted when wolves are at a kill or winter kill or elsewhere unless it is known that they have not eaten large amounts for at least a day or two.

6. Wolf captures and collaring should not be attempted when it is known that the wolves are outside their established territories, within their established territories where wolf hunting and trapping is permitted, or where there is current or impending human activity of any kind.

7. Any capture/collaring death or other mishap should trigger an immediate suspension of all captures and collaring until the cause is determined with reasonable certainty and remedial measures are in place. In each case, NPS should conduct a serious investigation and ensure that there is a high quality scientific review. All carcass remains and other useful evidence should be secured immediately according to proper law enforcement and scientific standards. There should not be any necropsying or other disposition of the remains until a sequence of uses and procedures that would maximize investigative and scientific returns – including by any non-NPS scientist studying these wolves - has been carefully set forth.

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Appendix I

"Family" and "family lineage" vs. "pack"

Wolves typically live in social groups consisting of breeding adults and their offspring from multiple years. Simply put, they live in "families," most commonly extended families, in both biological and common sense interpretations of the term. "Family" is not human-specific. Along with related terms such as "mother," "father," "daughter," "sister," "brother," and "uncle," it has long seen routine use in the world's leading scientific journals (e.g., Science, Nature, Conservation Biology) in papers about aspects of social organization in non-human species.

Use of "family" with regard to wolves is sometimes belittled in Alaska. However the joke is really on the biologists, reporters, and others who do the belittling. A biologist who chuckles at the use of this term for wolves or other species reveals his or her ignorance of the scientific literature and about one of the most active areas in all of science (sociobiology) – and sometimes also betrays an underlying social or political agenda (Alcock 2001).

"Pack" is unscientific and misleading. Not only does it fail to convey the fascinating essence of what sets wolf social organization apart from the organization of many other species (Haber 1996) but it connotes almost the opposite. It is used by many biologists and others for little reason other than that many use it.

By "family lineage" I refer to the continuity arising from combined learning-based and genetic transfer of information across generations of a family. The genetic portion of this continuity might erode progressively through "dilution" (Mech et al 1998), but learned traditions in hunting methods, use of the same core territory, homesites, travel routes, and in other aspects of behavior are likely to remain strong, as observed for Toklat and Savage (Haber 1977

and unpublished data). Learning and resulting traditions assume particular importance where there is prolonged dependency of the young, such as in moose-dependent wolves (Haber 1977).

Farm family lineages, e.g., in Nebraska, provide a rough analogy. Many have turned over. Here and there others have persisted for a hundred years or more, especially where soil and water conditions are the best. Family members breed, die, and disperse on/from the farm, and newcomers are added now and then through marriage and adoption. But even in an old lineage the early genes still have a recognizable presence. There are also strong family memories and traditions. Most of the original farmstead remains in production, though some inferior acreage has been sold on one side and some productive neighboring acreage has been annexed on another. The original (renovated) house and barn are still home.

Distinct short-lived and persistent farm family lineages can be identified in mosaics across the landscape. And for the oldest of these we recognize important cultural, esthetic, biological, and other values – just as we should recognize the enormous values of an old non-human family lineage such as the Toklat wolves of Denali National Park.