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Raptors, Rodents and Rare Weather: Managing Increased Migratory Raptor Populations at McConnell AFB, Kansas

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Abstract: Migratory raptor populations at McConnell Air Force Base in Kansas, increased dramatically in the 2008-2009 winter season, with more than a 200% increase in the number of large hawks observed on the airfield, compared to equivalent seasons in the past 3 years. This increase resulted in frequent interruptions and/or cessations of flying operations.
The primary cause was determined to be a local explosion of both Hispid Cotton Rats (Sigmodon hispidus) and Prairie Voles (Microtus ochrogaster). The cotton rat explosion was a result of record-breaking rainfall in 2008, while the explosion of voles followed the natural 3-5 year cycle. This overabundance of prey coupled with an unusually warm winter provided an ideal wintering habitat for the raptors.
Because harassment proved futile, the solution seemed to be to address the rodent populations, through the use of rodenticides. However the selection and application of a viable rodenticide, for a military airfield, presented a new set of problems. The final solution for non-lethal control of the raptors was to attempt relocations. Because of the migratory nature of the hawks, short distance relocations (70-120 miles) were preformed. This paper covers the problems, solutions, and results of our efforts to control the migratory raptor populations.

Background:

McConnell Air Force Base located on the outskirts of Wichita, Kansas is home to two resident, breeding pairs of Red-tailed hawks (*Buteo jamaicensis*) as well as two resident, breeding pairs of American kestrel (*Falco sparverius*). These pairs have successfully established and defended their territories from interlopers for at least the past 4 years. For the purpose of this paper territoriality will be defined as the defense of resources within a given area, it is not intended to refer to the defense of an area itself. Thus the territorial responses of an individual can and will shift with the fluctuations in resource availability. Therefore until recently since the base has been limited to these four pairs of residents, it can be assumed that the area could only support this number of breeding raptors. It should also be noted that while both Red-tailed hawks and American kestrels in North America are seasonally migratory, McConnell AFB is located far enough south that neither of these species migrate from the area in winter. Generally the winters are cold and sever enough though, that northern migrants continue further south in search of better wintering grounds.

Because these resident raptors have survived multiple seasons in close proximity to and hunting on the airfield they have learned to avoid the aircraft (referred to, for the purpose of this paper, as “experienced”). If they had not learned how to avoid the aircraft they would not have survived in these territories. The Wildlife Management and base personnel are reminded of this fact every fall, when these pairs bring their fledglings to the airfield to teach them to hunt. It is

not unusual for one or more of these inexperienced fledglings to be involved in a strike incident. Since they are new to the airfield environment they have not yet learned to avoid the aircraft and are much more likely to fly or dive in front of one then their parents are. Because the level experience of the resident pairs greatly decreases the chances of one of the residents being involved in a strike Wildlife Management at McConnell AFB has opted not to harass these individuals. Knowing that the carrying capacity of the base has been reached, we also know that if one of these pairs were to be lost the open niche would be filled, and it would take an undetermined amount of time to reestablish a new experienced pair. During the time of reestablishment the likelihood of strike incidents with raptors would increase dramatically.

The Problem:

In past winters it has been typical to see juvenile Red-tailed hawks, Northern Harriers (*Circus cyaneus*), Swainson's hawks (*Buteo swainsoni*), Sharp-shinned hawks (*Accipiter striatus*), and other raptors pass through the airfield at McConnell on their migration routes. Generally they have lingered for several days at most before continuing on. On average there were 10.3 observations of raptors (excluding kestrels) per month from December through March of 2007-2008 (these are total sightings, most likely of the same hawks on different days). At most 3 raptors were observed at one time. In the same time frame for the 2005-2006 season, there were an average of 12.5 interventions involving raptors recorded. While data for February and March are missing for 2007, and average of 9.5 interventions per month were recorded for December and January. These again are indicative of events on multiple days most likely involving some of the same individuals. Although the data is recorded by different entities and using different methods a consistent number of raptors observed on the airfield in the winter months is clear. However this all changed dramatically in the 2008-2009 winter season, when there was a significant increase in the number of raptors being observed. During the same time period in 2008-2009 season there was an average of 169.25 raptor sighting per month on the airfield. Even allowing for a 100% margin of error when comparing the data across years (to allow for the differences in collection methods and observers), McConnell AFB was still looking at a raptor population 6.8 times larger than the highest previous year recorded. While the greatest number of raptors observed utilizing the airfield at one time jumped from 3 the previous season to 24 in the 2008-2009 season.

Raptor populations on the airfield rose steadily from December through March. Since Wildlife Management efforts are primarily concentrated on migratory geese during this time of year, the increase in the number of raptors first came to attention after four consecutive strikes occurred on the runways, between December 31st and January 12th. Each of these strikes involved either a Red-tailed hawk, a Short-eared owl (*Asio flammeus*) or a Northern harrier, during a time of year when there are historically no birdstrikes involving raptors. Although none of these strikes caused any damage to the aircraft, they did raise the alarm that something was different this year. The first step was to take a closer look at what was happening with the

raptors. Why the sudden increase? What were we looking at in terms of the species and populations present at that time?

After some closer observation, we were able to determine that we were dealing with several populations. There was a roost of Short-eared owls (estimates based on observations put the total roost population at approximately 10-12 individuals). This roost was believed to be located in a field in the Northern Clear Zone of the airfield, the exact location was not found, however the owls were arriving from the same area nightly/daily (on overcast days) to hunt on the airfield. There was also a smaller population of Northern harriers present throughout this time frame. This population consisted of one adult male, 3 adult females, and 2-3 juveniles. It is very possible that the harriers were roosting with the owls. Both are ground nesters and are known to share communal roosts in the winter months. While the presence of these populations was troubling, more troubling was the striking increase in the numbers of juvenile Red-tails. The resident pairs had successfully fledged their young by the end of September. Based on data from previous years we knew that the juveniles of these pairs had usually left their parents' territories by the late fall, and indeed they were not observed on the airfield throughout October. When the number of Red-tails on the airfield jumped from an average of 3 at a time to upwards of 10 (mostly juveniles), it was obvious that these were migratory hawks. The assumption in December was that they were passing through, however by the end of January, when the numbers had increased to a steady average of 7 at a time it became apparent that these hawks were not continuing on along their migration routes. Several other species of raptors, not usually seen more than once or twice a year had also become regulars on the airfield, in low numbers. These included several Prairie falcons (*Falco mexicanus*), a pair of Swainson's hawks and at least one Merlin (*Falco columbarius*).

The strikes involving the raptors were not the only problem that they presented. The Bird/Wildlife Aircraft Strike Hazard (BASH) regulations at McConnell AFB, as do most BASH regulations, have strict guidelines limiting the capabilities of aircraft to utilize the runways and aerodrome, based on the current Bird Hazard Condition (BHC) . The BHC is contingent on both the number of birds as well as the size of those birds. The regulations read as follows:

Bird Hazard Conditions (BHC) Bird activity includes any birds that may create a hazard. Standard McConnell AFB BHCs warn aircrew and support personnel of the current bird threat to operations. Conditions are:

LOW: Normal bird activity – as a guide, fewer than 5 large birds (waterfowl, raptors, gulls, etc.) or 15 small birds (terns, swallows, etc.) on or above the airfield , with a low probability of hazard.

MODERATE: Increased bird population (as a guide 5-15 large birds or 15 to 30 small birds) in locations that represent an increased potential for strike.

SEVERE: Defined as high bird population (as a guide more than 15 large birds or 30 small birds) on or immediately above the runway or other specific locations (taxiways, infield areas, departure or arrival corridors, etc.) that represent a high potential for strike.

BHC LOW: There are no restrictions to operations when BHC is reported **LOW**.
BHC MODERATE: All local IFR/VFR traffic pattern activity will cease (regardless of home station or tasking authority): airborne aircraft/crews will terminate transition training in the McConnell local pattern. Aircraft commanders will be the approving authority for initial takeoffs and full-stop landings during BHC **MODERATE**, provided arrival and departure routes avoid bird activity.
BHC SEVERE: Anytime the McConnell BHC is **SEVERE,** all takeoffs and landings are prohibited. Airborne aircraft will divert or hold.

Thus even though there were no further strikes involving larger raptors after early January, flying operations were repeatedly interrupted by the numbers of raptors utilizing the airfield. Multiple observations of more than 15 raptors either on the ground or in the air above the airfield during the winter months forced the BCH into SEVERE. In order to insure uninterrupted flying operations for McConnell it was necessary to address the issue of how to successfully reduce the number of raptors.

With this need came the question of why the increase in numbers was occurring and why was the usual territoriality of our resident hawks not being seen. Several possibilities seemed apparent:

1) We had lost one or two of our residents, either in the strikes that had occurred (the remains of which were not enough in one case to identify the age) or to natural causes. This would result in exactly the situation we hope to avoid by not disturbing these breeding pairs; a niche would be opened up at exactly the worst time. Being in the migration season, it would mean that the numbers of young hawks without established territories of their own would be there to vie for this now open territory.
2) There were simply an unusually high number of migrant hawks. Migration patterns of raptors are often dependant on weather patterns. With the Sedgwick county area (where McConnell AFB is located) experiencing a mild winter, it may have been possible that these raptors simply were not moving further south because of a lack of cold or snow (see Chart 1) to drive them to do so. Or we could be experiencing a natural population fluctuation.
3) The final possibility was that the availability of resources within these territories had shifted. An overabundance of prey availability would result in both the tendency for migratory raptors to stay in the area and for the reduction in territoriality from our residents as well as new raptors.

Before any steps could be taken to resolve the issue of these high raptor numbers it was necessary to determine which of these scenarios was the most likely cause.

Table 1: 2008-2009 Deviations from Normal Mean Monthly Temperatures and Snowfall at McConnell AFB

Month	Normal Mean Snowfall (in.)	Deviation from Mean	Normal Mean Temp. (F)	Observed Mean Temp. (F)	Deviation from Mean (F)
November '08	1.7	-1.7	44.2	46.2	+2.0
December '08	4.6	+0.4	30.2	32.6	+2.4
January '09	4.6	-3.0	30.2	32.2	+2.0
February '09*	3.9	-3.9	42.4	48.5	+6.1
March '09	2.2	+4.6	45.9	47.8	+1.9

Source: **National Oceanic and Atmospheric Administration and National Weather Service database.**
* Information for February is preliminary Monthly Climate Data, all other data is from Monthly Summaries.

Determining a Cause:

Due to the fact that the resident hawks at McConnell are not banded or marked in any way, determining whether or not we had lost one was not possible over the winter. The only way to know for sure was to wait for the breeding season, to see if the pairs were intact. The fact that even if we could determine for sure if the pairs were intact or not, there would have been nothing we could do about it anyway. Thus we began to look at the other possible causes.

The first step was to contact local experts to find out if the Red-tail population was unusually high in the area in general. The data from the 2009 Audubon Christmas Bird Count (CBC) showed twice the number (83) of Red-tails as the previous year (35), but fewer than the 2007 count (119) in Wichita. Representatives from the USDA, Kansas Department of Wildlife and Parks, and the Great Plains Nature Center, were contacted. All of these sources confirmed that the overall migratory population did seem slightly larger than normal; however there were microhabitats that seemed particularly flooded with Red-tails. They also confirmed that the roost of Short-eared owls being in Wichita was unusual for that time of year. No short-eared owls were recorded in any of the Wichita CBC's from 2007-2009. The key information that came from these contacts was the fact that the Wichita area was in a crest year in the prairie vole (*Microtus ochrogaster*) population cycle. This also matched with the evidence of a high number of rodent runways both on and off the airfield.

In order to determine exactly what type of rodents were building the runways and burrows we set up a trapping grid on the airfield. The assumption was that we were going to catch primarily prairie voles. Unfortunately we did not have any baseline data on normal vole population levels on the base, so the trapping was designed simply to make sure that voles were the problem species. Three trapping grids were laid out in early January. Because we were not looking for population numbers, just for a sampling species, the grids were not randomly laid out on the airfield. Instead they were evenly spaced diagonally along the length of the airfield. Each grid was 25 x 25 meters, with traps set every 5 meters, totaling 25 traps per meter. The traps

were baited with oats and peanut butter and trapping was conducted for 3 consecutive nights. The results were not what we had expected.

One of the plots resulted in no traps being sprung, even though there were active runways running through the grid. One plot resulted in 2 prairie voles and one least shrew (*Cryptotis parva*) being trapped and 3 sprung traps (showing evidence of the rodents being lost to scavengers). This plot was on the most arid of the three sites. The third plot resulted in 1 prairie vole and 7 Hispid cotton rats (*Sigmodon hispidus*) being trapped and 4 sprung traps. This plot was in the wettest of the sites. With this new evidence of the possibility on a high cotton rat population, we took a closer look at the fecal evidence in the runways. A comparison of fecal droppings sizes indicated that while both species were active on the airfield the higher population was of the hispid cotton rats. This was further supported as the inspection of owl pellets showed a higher number of cotton rat skulls than vole skulls. Throughout the rest of the winter over 90% of the prey examined when a hawk was scared off their catch, turned out to be cotton rats.

The obvious conclusion was that a combination of a mild winter, allowing for easier hunting and more frequent rodent activity, and a high rodent population were the cause of the extremely high number of raptors wintering over on the base.

Problems within Solutions:

The 2008 spring and fall seasons produced some of the highest rainfall totals on record (see Table 2). Common thought is that cotton rat populations correlate with heavy rainfall, when the extra rains produce higher amounts of forage availability. In Texas cotton rat explosions have been positively correlated with years of high rainfall. It is suggested that they are particularly subject to climatic changes in the marginal regions of their range (Bradly, 1994). While several studies have failed to support correlations between years of heavy rainfall and high hispid cotton rat populations in Kansas (Cameron and Spencer, 1981; Rehmeier, et al, 2005), the local explosion in the Wichita area seemed to correlate with this record breaking season. In fact other papers have shown a correlation in spring decline of populations and heavy rainfall/flooding in early spring (Sullivan, 1995). Cotton rat populations in Kansas show the lowest population levels in the spring, with a single peak in populations in the fall, thus making the population more susceptible long term effects of high mortality in the spring (Cameron and Spencer, 1981; Rehmeier, et al, 2005). Obviously the record rainfalls did not impede the Wichita area populations, instead they thrived. Even the late flooding in the fall had little to no affect on decreasing the population. This may have been a timing issue. With the heavy rains starting late in the spring (May instead of March) they may not have had the same affect on the winter stressed populations, that early flooding has. In fact the cotton rat population at McConnell suffered high mortality after a late blizzard in March, which resulted in heavy flooding after a quick melt (over 40 cotton rat carcasses were found on the tarmac alone, immediately following the melt). These same studies suggest a positive correlation between mild winters and high fall population counts. The 2007-2008 winter season was not particularly mild however, temperature and snowfall averages were within the norms expected for the season. So with no clear

explanation for the eruption in cotton rat populations the question of it being habitat related was valid.

Table 2: 2008 Rainfall Data

2008 Month	Total Observed Rainfall (in)	Deviation from Normal (in)
March+	3.08	+0.37
April+	1.82	-0.72
May*+	13.14	+8.98
June	7.42	+3.17
July	3.82	+0.51
August	3.00	+0.06
September^	12.96	+10.00

*** This was the wettest May on record, with records dating back to 1885.**
+ The spring season was the second wettest on record, with a total of 18.04 inches of rain.
^ September set the highest ever recorded amount of rainfall for the area in a 24 hr period. (10.31")

Source: **National Oceanic and Atmospheric Administration and National Weather Service database.**

One of the first questions raised by base personnel was; was the long grass regime on the airfield a contributing cause of the high cotton rat population and if it was could the issue be solved by getting rid of the grass? The long grass regime at McConnell calls for the airfield grass to be kept between 10"-14", this is a newer practice for the base that was started in mid-2007. The simple answer was that evidence of cotton rats and of raptors hunting on other parts of the base (primarily on the golf course, where the grass is manicured) indicated that this was not the case. In order to further support this we contacted several local mammalogists who further confirmed that the explosion in the cotton rat population was not limited to the base. In fact the increased use of the airfield by raptors over the winter was not limited to McConnell, Wichita Mid-Continent Airport and several smaller airfields were experiencing the same issue. (Although trapping at Mid-Continent resulted in higher prairie vole populations and no cotton rats. The trapping at Mid-Continent was also conducted much later in the season which may have affected differences in the results.)

While being able to show that the cotton rat explosion was not limited to the McConnell airfield, we still needed to address the question of cutting or burning the grass in order to reduce the population. Neither of these options was appealing in the middle of the migration season. The long grass has proven very effective in keeping flocking birds (which are in great abundance else ware, both on and off the base) off of the airfield. Thus cutting or burning the grass during the non-growing season would result in a trade-off, the benefits of which did not seem to outweigh the costs. There was also no guarantee that cutting the grass wouldn't simply compound the issue, by eliminating what little coverage the grass afforded the rodents from predation. Exposing them further may have only resulted in increased raptor numbers. As for burning the grass all evidence suggests that this would have been a tragic mistake. While different studies

may not agree on what controls the population densities of cotton rats in Kansas, they do all agree that cotton rats flourish on previously burned sites.

According to Rehmeier et al, cotton rat populations are negatively affected immediately after burns, but tend to increase past previous numbers in the first two years following a fire, before leveling off. So while burning the grass on the airfield may have temporarily reduced cotton rat numbers, the problem would have rebounded with worse results the following year. Several papers reported by Sullivan had the same findings. They also reported that direct cotton rat mortality as a result of fires was extremely low, since the rats tended to flee the fire or take refuge in burrows. These survivors then returned to the same areas once vegetation began to re-grow. Cotton rats show an affinity for disturbed sites, most likely due to the stimulation of early stage vegetative growth, providing high rates of forage availability. These papers also suggest that cotton rat populations soar on recently burned sites for these reasons (Sullivan, 1995).

If indirect intervention (i.e. habitat manipulation) was not the answer to solving the rodent problem, and thus the raptor issue, it seemed that the next solution to look at was a direct intervention (i.e. rodenticides). If we could find a rodenticide that was effective on both cotton rats and prairie voles and could be used effectively over a large area we should be able to reduce the rodent population enough to cause the raptors to move on. Although we found just such a rodenticide, the potential use of this rodenticide only presented more problems.

Problems with Rodenticides:

The primary concerns with using a rodenticide were multifold. First we needed one that worked on multiple species, second we needed one that had no secondary toxicity, as we did not want to be poisoning scavengers, third we needed to be able to use it on a large area (approximately 600 acres), and finally we needed a rodenticide that was labeled for use on a military airfield. We thought we had found what we needed in the form of Prozap® Zinc Phosphide Pellets. This is a rodenticide specifically labled for use on military airfields and more specifically for the use in the control of vole populations in order to “reduce the potential for air-strikes with birds feeding on voles”. Not only was this just what we were looking for , but Zinc Phosphide (ZP) is one of the only rodenticides that has been proven effective on cotton rats when used on fields. So what were the problems?

The first issue was a matter of timing. Prozap® is baited on oats or grain and a pre-baiting application is recommended to avoid bait shyness. In order ensure the pre-baiting is effective it is recommended that the untreated bait be applied several days prior to the treated bait. Next the proposal to use a rodenticide would have to be approved through Air Mobility Command (AMC). This approval process would most likely take at least a week. Then because we were dealing with a military installation the application process needed to be contracted out to a licensed applicator, both for health and safety reasons as well as for the equipment. The contracting process would have taken a minimum of three weeks, and then at least another week before the pre-bait and rodenticide could be applied to the entire airfield. By the time this potential solution was able to be presented to the various departments involved on the base it was

already early February. This meant that the rodenticide would not be applied until mid-March at the very earliest. Mid to late March was when we were expecting to see a natural decrease in the cotton rat population as well as the beginnings of the northern migration of the raptors. Thus it seemed that while this was a solution we should continue to look into, the fact was it was not an immediate solution by any means.

The second issue was raised when we spoke to the company representative about the effects of this poison in terms of how fast acting it is. We were informed that the rodenticide would result in the rodents dying immediately, where they ate it. This had the potential of causing a new problem on the airfield. If we were to scatter bait the entire airfield, resulting in dead rodents across the entire area we would then be presented with the issue of attracting scavengers. Multiple days of vultures, crows, and gulls, etc. could be more disruptive than were the current raptors. This could have been tested through the use of a test plot or avoided by furrow baiting. Furrow baiting, however would be time intensive and did not guarantee the result rates of scatter baiting. These concerns were once again alleviated only to be replaced by new ones when we discovered that Whiteman AFB had successfully used ZP on their airfield.

It was apparent that the chances of AMC approving the use of ZP were slim at best and the process would take far longer than first expected. In 2005 Whiteman AFB, applied for the use of ZP on their airfield to resolve an almost identical problem. After several damaging strikes involving raptors and assessment of their BASH program it was recommended that they be allowed to apply the ZP. However prior to application, compliance with the National Environmental Policy Act and the writing of an Environmental Assessment were required by law. The fact that through an aggressive BASH program McConnell had avoided any damaging strikes reduced the likelihood that approval would be granted. Even with approval the additional delays required by these compliances would have a made the immediate need for a solution impossible to meet.

The third obstacle indirectly presented what would be another delay in the application process. Prozap® although labeled for use on military airfields, may not be applied to grass longer than 7.5 inches. The McConnell BASH program ensures that the grass is left at a height of between 10 and 14 inches after the last fall mowing. Again this would have required bringing in a contractor off season to mow the grass in order to prevent off label application.

Final Outcome:

The ultimate decision to deal with the raptor problem was two pronged. It was decided that both a long term and a short term approach should be utilized. For the long term the goal was to continue to look into the use of ZP, should it prove necessary to use it in years to come, as well as to establish monocrop of grass on the airfield in order to reduce the attractiveness to rodents. The short term approach was to instigate a trapping and relocation program for the raptors.

The assessment of the need to monocrop the airfield was not a new idea; however the increase in raptors was the instigation to start the process. The airfield at McConnell has never

been seeded with a Monocrop in mind. Up until the mid 1980's the rangeland grasses on the airfield were harvested annually as hay. The airfield currently consists of a mixture of grasses and broadleaf plants. An assessment of the airfield in 2008 resulted in 70 species of broadleaf plants being present. The high percentage of dicotyledons on the airfield provides ideal forage for many rodent species. The goal is to eliminate the broadleaf plants, while establishing a monocrop of less palatable grass than is currently present.

In the short term it was decided to that an attempt to trap and relocate as many raptors as possible would be made. McConnell opted to try relocations over depredation for several reasons, the primary reason being that the BASH program at McConnell utilizes lethal control only as a last resort. The uses of other methods, over the use of lethal control, have been shown to be far more effective in the long term success of the BASH program at McConnell. Aside from the desire to avoid lethal control, there were several other pragmatic reasons to opt for a relocation program over depredations. The first of these was the fact that there was no guarantee that depredated raptors would not be immediately replaced by other raptors in the area, that would fill the open niche. Should this be the case, then we would have used up the depredation permit limits for the year to no avail, leaving ourselves with no other options down the line (including accidental depredations during trapping). The limits placed on depredations were another deciding factor. It was far more likely that we would be granted higher numbers of relocations per species than depredations. Also by using relocations we could test the theory of the open niches being filled, before using any of the depredation allotments. Should the relocations prove ineffective, we could always fall back on depredation if necessary.

In order to ensure that we did not disrupt the resident pairs of Red-tails it was decided that only juveniles would be relocated, since the majority of the interlopers were juveniles this would allow the removal of most of the migratory hawks. In order to insure the health of the trapped hawks prior to release and the suitability of release sites efforts were coordinated with a local raptor rehabilitator. It was also decided that due to a lack of home territory affinity and the migratory nature of the hawks being targeted, the relocations would not need to be greater than 80 miles, so long as they were relocated along their migration paths. Due to delays in obtaining relocation permits the trapping was not instigated until the beginning of March.

Trapping was performed using a bal-charti trap that was modified for larger raptors. The early trapping attempts using various rodents (mice and gerbils) as bait were unsuccessful. The assumption was that with the prey abundance on the airfield these species, being much smaller than the available cotton rats, were not attractive enough to draw in the raptors. The bait was switched to a pigeon, which proved to be more effective, but the success rate was still low (>30% capture rate per trapping attempt). Although the trap itself was highly successful, with 100% of the hawks that attempted to strike the prey being captured, the actual strike rate per trap setting was low. In total three juvenile Red-tails were relocated. These were each marked with temporary tail markings, so that return rates could be monitored. While each of these hawks was relocated fewer than 70 miles northwest of McConnell, the return rate was zero.

Within three weeks of beginning the trapping and relocations the raptor populations began to decline. The initial decline was seen in the Red-tail populations, followed by the short-eared owls and the northern harriers respectively. By the beginning of April the populations had returned to normal.

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