# Report to the House Committee on Vog – July 10, 2008

The effect of Vog on Livestock Operations in the Kau District

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This report was generated following a field survey of the pasture conditions in the Kau district July 2, 2008. During this field survey I spoke with ranchers, walked through pasture, and assessed condition and damage of the forage resources and the infrastructure as a result of the vog. This trip was very revealing; damages are more widespread than I had suspected and long-term consequences will be significant, especially on the infrastructure of the ranches downwind of the vents. This report summarizes my observations and the information I gathered from the ranchers.

**Nature and Extent of Vog Impact on Livestock Operations**

Initial surveys were conducted in pastures located within 6 miles of the Kilauea Caldera and directly west and downwind of the prevailing wind direction. Ranchers in the area indicated that the vog cloud covers much of area 4-5 days per week with vog density substantial enough to limit visibility and cause respiratory discomfort while working.

**Pasture condition**

I walked several pastures in the Kau district ranging in elevation from 2500 ft to 3500 ft and from within 6 and out to 14 miles from the vent. I observed several varieties of forages including several varieties of grasses (Kikuyu, Guinea, pangoloa, and several other varieties), pasture legumes, various trees and shrubs. Damage to grass forages was highly variable over the range of pastures and across different varieties of grasses that I observed. Damage on the forage grasses was evident along the margins of photosynthetically active leaves as brown dead material. Some damage to the leaf material was evident in all pastures, but the extent of the damage seemed to depend on the productivity of the pasture. Over the range of pastures that I observed, distance did not seem to have an effect on the extent of the damage; that is, I observed similar patterns of damage a 14 miles from the vent as I did at 6 miles from the vent. More fertile pastures, and recently grazed pastures, tended to show less damage. In the case of the former, more fertile plants are better able to cope with the added stress of the vog. As for the latter, the new growth of recently grazed grasses are less likely to reach tolerance thresholds beyond which damage becomes evident as would be observed in more mature plants. In the most heavily damaged areas I estimated that 70-75% of the grass leaf material showed signs of leaf damage. In the least damaged pastures the number of damaged leaves decreased to less than 35% of the live green tissue. Despite a wetter than normal spring and early summer forage production seemed slow, though this is not uniformly true for all forage grasses I observed. The depressed growth rates observed could be the result of poor light quality and quantity as a result of the vog cloud and not an impact of the vog gasses themselves. However, Bunce (1985), in his paper on *"Fluorine in Air, Grass and Cattle*", indicated that similar damage to what I observed in the Kapapala area was due to the effect of Fluorine gas on plant metabolism.

Within the range of pastures that I observed forage legumes, shrubs, and trees all showed significant levels of stress and extensive leaf damage and die-back. This level of damage occurred equally at all elevations and across the entire 14 mile stretch from the vent. Damage on the forage legumes was evident as large blotches of dead material all across the leaf surface, with leaf margins also showing damage as well. Some trees and shrubs had lost all or most of their leaves and in some areas several individual trees and shrubs were observed that had recently died. Cohorts within close proximity to these dead individuals showed significant levels of stress as well. There is a 30-40% reduction in legume productivity and as much as 80% of the leaf material showed damage in some areas. Virtually every tree and shrub I observed showed signs of chlorotic and necrotic leaves.

**Ranch and Pasture Infrastructure**

I also surveyed vog damage to ranch and pasture infrastructure. Vog damage to fence and waterlines is extensive all across the area observed. Galvanized posts, wire, gates, panels, and pipe are losing the galvanized coating. Where the coating has completely melted away the iron material is now rusting at an accelerated rate. Several galvanized swing gates that were just over one year old showed areas of rust. Fence wire with a 10 year guaranteed life are nearly rusted through after only being in place for a few years (the ranchers indicated that until recently the rust was not present on the wire). Exposed galvanized water pipes showed areas extensive rust damage. Rust along the length of the pipes appeared to be restricted to the wind-ward sides of the pipe, where wind driven rain and moisture collect. For the most part the rust damage along the exposed portions of the pipe looked to be a recent development and in fact, adjacent lengths of pipe that were more protected from the elements, either from the plant canopy or by some obstruction between the pipe and prevailing winds, showed little damage.

The potential economic impact of the vog on ranch infrastructure is extremely great. Replacing fence costs as much as $4.00 – $5.00 per linear foot. Water infrastructure is even more expensive. Losses of these two elements alone could prove to be too costly for the ranches to replace.

It is important to point out at this juncture that many ranchers in the Kau district, as well as other districts, lease considerable amounts of land from the state. The benefit to the state these ranchers perform through maintenance of infrastructure such as fences, water-lines and catchment facilities, and roads is invaluable. True, maintenance of the lease infrastructure is generally part of their lease agreements, but the cost they incur saves the state a substantial amount of money. With the infrastructure rusting away at an accelerated rate because of the vog on some of these leases the cost of maintenance will quickly become too much for the ranches to bare alone. Perhaps a low interest agricultural loan program could be developed specifically to assist ranches with infrastructure maintenance efforts in affected districts.

**Animal Welfare**

Cattle, goats, and horses were all observed during the survey of the Kau district. The animals observed did not show signs of adverse health conditions that might be the result of the vog. That is, I did not observe signs of respiratory distress or disorders, nor did I observe any eye problems in the animals. However, the vog was not particularly heavy on the day of the survey. Thus, the fact that it was not observed on that day does not diminish the possibility of respiratory disorders developing in the livestock in the area. In fact, ranchers whom I spoke with indicated that on heavy vog days they do observe watery eyes in the animals and what seems an elevated incidence of respiratory distress. These symptoms seem to be somewhat transient and thus fluctuate with the density and duration of the vog cloud. On the other hand, an indirect affect of the vog is the impact on forage quality and quantity. If forage quality and quantity continues to be impacted animal thrift and well being will begin to be adversely affected. That this was not observed yet could simply be because not a sufficient amount of time has passed since the beginning of the increased eruption to result in an observable impact on animal health. In short, during this increased volcanic activity and emissions a heightened state of surveillance on livestock health needs to be maintained.

**Fluoride**

Of great concern is the potential for fluoride to accumulate in the forages downwind of the vent. The USGS noted slightly elevated levels of fluoride in the atmosphere some distance downwind of the vent. They contacted me regarding the potential impact on livestock from the dry-fall of fluorine onto the forages. While this may be an issue, it is more important to note that fluorine is readily absorbed and incorporated into the tissue of plants. Fluorine interferes with plant metabolism, affects productivity, and is readily incorporated into the plant tissue (Bunce 1985). Bunce (1985) noted that evidence of chlorosis and necorsis in grasses indicates that a threshold of tolerance has been reached and further accumulations could be toxic for the plants. Consumption of these forages by livestock, then, is of grave concern as Fluoride is toxic to animals. Forage and feed that contain more than 40 ppm (on a dry weight basis) of Fluoride will begin to reduce animal productivity, but mature animals may be able to tolerate elevated levels of Fluorine up to 50 ppm and maybe up to 100 ppm for short periods of time. Importantly, Bunce (1985) indicated that Fluorine storage in soft tissue is low so there is no threat of bioaccumulation of Fluoride in humans who consume meat and milk products from animals on forages with elevated Fluorine concentrations. Still, the incidence of elevated Fluorine downwind of the vents could have a significant economic impact on the livestock industry through reduced forage productivity and quality and reduced animal productivity.

Fluorine deposition away from the vent will diminish with distance and will be greatest in the direction of the prevailing wind. However, it is not currently known how much Fluoride is being deposited downwind of the vent. Nor do we clearly understand how much of it is being incorporated into the forages that are grazed by the livestock in the area. We need to determine these parameters so that producers can make informed and timely decisions; decisions that will most certainly affect their economic well being.

**What Needs To Be Done**

A program of surveillance and monitoring needs to be developed that will provide producers with up-to-date information on the potential impact of the vog on their operations. Air quality, which is already being monitored, should be coupled with samples of forages downwind of the vent to monitor fluorine concentrations. This information could then be used by the producers to make management decisions regarding their livestock. Monitoring stations should be established at set intervals (1 – 2 mile distances) leading downwind away from the vent. Forage samples should be collected from these locations on at least a quarterly basis. The number of samples collected at each location should be statistically sufficient to minimize error to within 95% of the mean value. I estimate the initial sampling will require a total of 90 samples across 15 – 20 mile distance from the vent.

I have contacted a number of Laboratories to acquire cost estimates for analyzing forage for Fluorine content. The cost of analysis varies from $400 to $80 per sample depending on the procedures used by the Laboratory. This means the cost of the initial sampling would range between $36,000 and $7,200. Obviously, analyzing forages for Fluorine will be a costly endeavor; especially if it is carried out for a full year or longer. However, I would suggest that it will be more costly, economically and politically, if nothing is done to determine the extent of the impact of the Fluoride on the livestock industry in that region of the Big Island. People in general, and livestock producers specifically, may have a hard time understanding why they were not informed of the potential impacts until after it became a critical issue.

Respectfully submitted,

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