SURVEY OF THE TOTAL FECAL COLIFORMS, E. COLI AND FECAL STREPTOCOCCI IN WATER COLLECTED FROM SITES WITH AND WITHOUT BEEF CATTLE

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ABSTRACT: Phase I. Water sampling from four sites at the Prairie Research Unit was begun in the late winter of 2002. The sampling sites are described as follows: **Sampling site 1 A (SS1A)** is from a roadside ditch, that is a part the headwaters of Fuller Creek, prior to the creek entering the pasture and was added in September of 2002 to determine any preexisting bacterial load for **Sampling Site 1**. **Sampling site 1 (SS1)** is from Fuller Creek (one-quarter mile downstream from **SS1A)**, which collects the runoff water from approximately 275 acres, and this acreage has between 125 and 150 mature cows plus calves, grazing at most times of the year. **Sampling site 2 (SS2)** collects water from a grassed pasture of approximately 125 acres that has a variable stocking rate of cattle, and **Sampling site 3 (SS3)** collects water from a wooded and grass covered "pristine" area of approximately 150 acres that has no human or livestock contribution. Aliquots from these samples were filtered and the filtrate plated onto selective media to allow bacteria to grow and reported as colonies per 100 ml of water. *E. coli* numbers, indicative of fecal contamination, vary within areas and between areas at different sampling times. When rainfall events were frequent, most bacteria counts remained below 20,000 counts/ml. In late October and November of both 2002 and 2003, the *E. coli* counts in the pristine area increased dramatically from a normal of approximately 5000 to over 40,000 counts/ml. This pattern repeated itself in 2004. This timing coincides with blackbird migrations into the area and the wooded area on this site provides a prime roosting habitat. Generally samples collected from areas that contain cattle runoff have higher bacteria counts, but counts in samples from the roadside ditch (pre-cow, **AREA 1A)** were sometimes as high as those from **AREA 1,** approximately one quarter mile downstream, that contains water contributed from **1A,** but also runoff water from 275 acres where 150 cow-calf pairs graze. Cattle do indeed excrete bacteria in fecal material, but forages filter runoff water trapping bacteria and subjecting them to hostile environments such as heat and ultraviolet radiation. Preliminary research indicates that bacteria in runoff waters vary, even in pristine areas, and that all bacteria from streams running through and beside areas where cattle graze may not be from cattle only. As seen from this survey, measuring total coliforms in watersheds does measure fecal contamination but does not provide information as to contributing species. DNA fingerprinting, to determine the percentage of each contributing species, domestic and wild, must be used to separate total bacteria counts.

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KEYWORDS: Beef cattle; runoff water; fecal bacteria; nutrient runoff.

MATERIALS AND METHODS: Duplicate water samples were collected from four different sites at the Prairie Research Unit beginning in the late winter of 2002. Samples were collected in sterile bags, resealed immediately and placed on ice. Aliquots from duplicate samples were pooled and then filtered, using the Membrane Filtration Method for Fecal Contaminants in Cattle Runoff, and the filtrate plated onto selective media to allow bacteria to grow. Total coliforms were evaluated by using the Standard Method 9222D of the American Public Health Association, 18th edition, 1992, fecal Streptococcus by Standard Method 9230C, and E. coli by the Standard Method 9213D. Once bacterial colonies developed, they were counted using the procedures prescribed by the Standard Method for each bacterial type. A generally accepted range for colonies is 50–200 per plate. An estimate of the number of colonies per 100 ml of water was calculated by dividing the total number of colonies by the volume of sample filtered. These were then reported as colonies per 100 ml as prescribed by the Standard Method 9222A. The areas sampled were **Sampling site 1A**, which is a roadside ditch that constitutes a portion of the headwaters of Fuller Creek. This sampling point is prior to the creek entering the pasture area and is used to determine any preexisting bacterial load for **Sampling site 1**. **Sampling site 1** was from Fuller Creek (one-quarter mile downstream from collection **Sampling site 1A**), which collects the runoff water from approximately 275 acres, which has between 125 and 150 mature cows with calves grazing at most times of the year. **Sampling site 2** collects water from a grassed pasture of approximately 125 acres that has a variable stocking rate of cattle, and **Sampling site 3** collects water from a wooded and grass covered **pristine** area of approximately 150 acres, that has no human or livestock fecal contribution.

RESULTS AND DISCUSSION: Bacteria numbers varied between areas and within areas at different sampling times (Figures 1-4). Runoff events occurring on a more regular basis tend to lower counts, assuming that the runoff areas were "flushed" of fecal material and their accompanying bacteria. Rainfall events that had less than one-inch accumulation usually did not have runoff if events occurred when soils were dry. *E. coli* counts for **Site 1A** were equal or higher than the **Site 1** area for several collections. Bacteria numbers in the creek decreased from **Site 1A** downstream to **Site 1**, even though runoff water from pastures that had over 125 cow-calf grazing pairs contributed to the water at the downstream collection point. It is possible to get a false perception and assume all bacteria in the water at **Site 1** are attributable to cattle if only total *E. coli* numbers were considered, but bacterial counts are relatively high at the upstream **Site 1A**. In many events, it appeared even that the water was "cleaned up" while it traveled through the pasture. Counts in the February through mid April are low in all years. The **Site 2** counts returned to pristine area bacterial levels within 30 days when cattle were removed and counts were relatively low even when cattle were present. As in erosion control, it is probable that grass and other vegetation slows down water flow, traps bacteria and subjects them to sunlight and its ultraviolet radiation. In 2004 as seen in some 2002 and 2003 runoff events, there were higher bacteria numbers from **Site 3**, the pristine area, than from areas that had farm animals. This pattern is relatively repeatable. A possible explanation for these higher bacterial counts in the pristine area is that wild animal numbers increased due to population

cycles or migratory behavior, of both birds and mammals into or out of the area. A DNA profile of the type of bacteria would be helpful in determining the exact contributing specie.

Figure 1. Graph of bacteria from water sample collected from a creek that drains approximately 275 acres on which 125 – 150 mature cows and their calves graze. Bacteria are reported as counts/ ml of water.

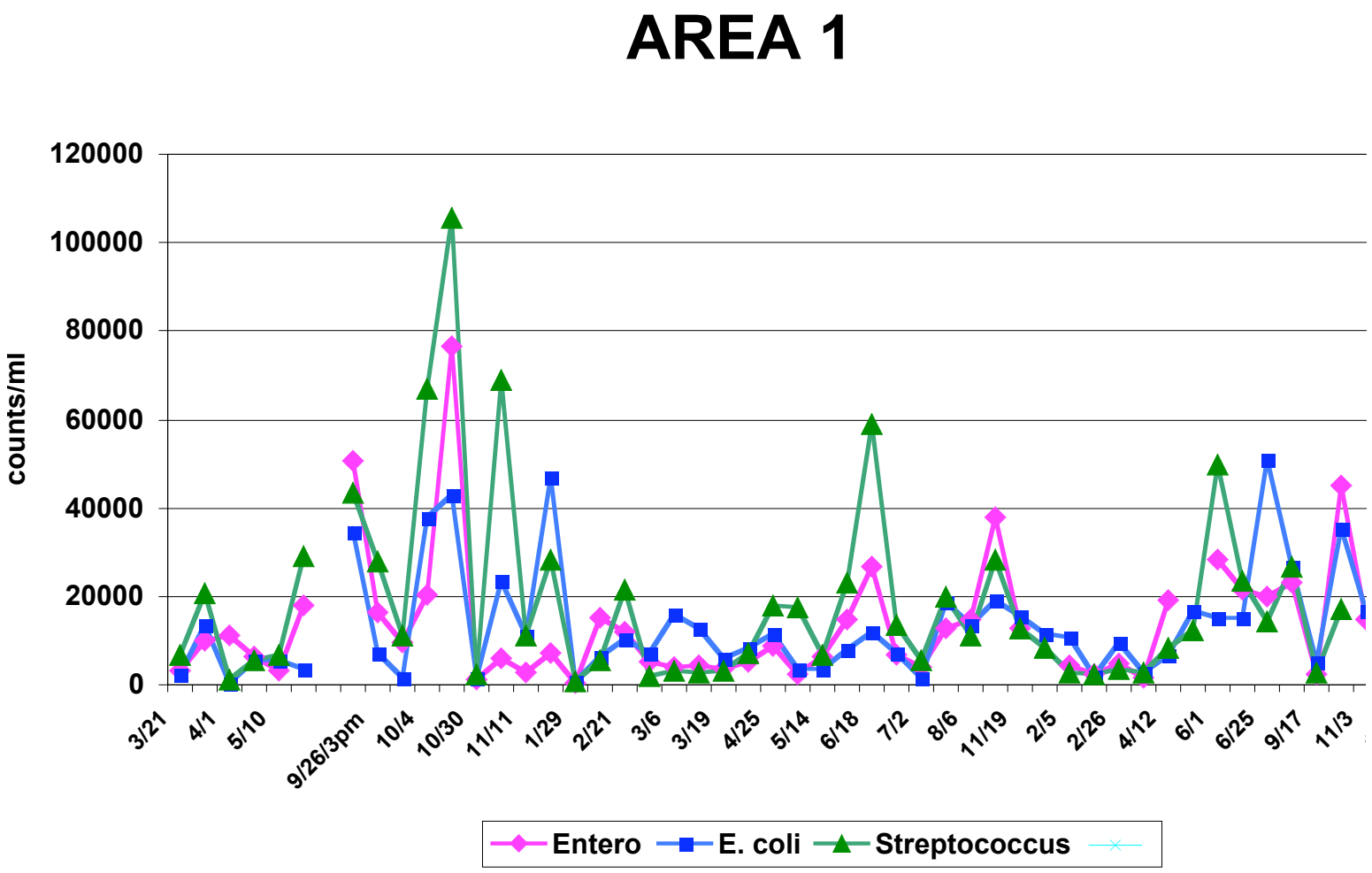

Figure 2. Graph of bacteria from a water sample collected from roadside ditch that is approximately one-quarter of a mile upstream from Sampling Site 1, prior to its entry into the pasture. Bacteria are reported as counts/ ml of water.

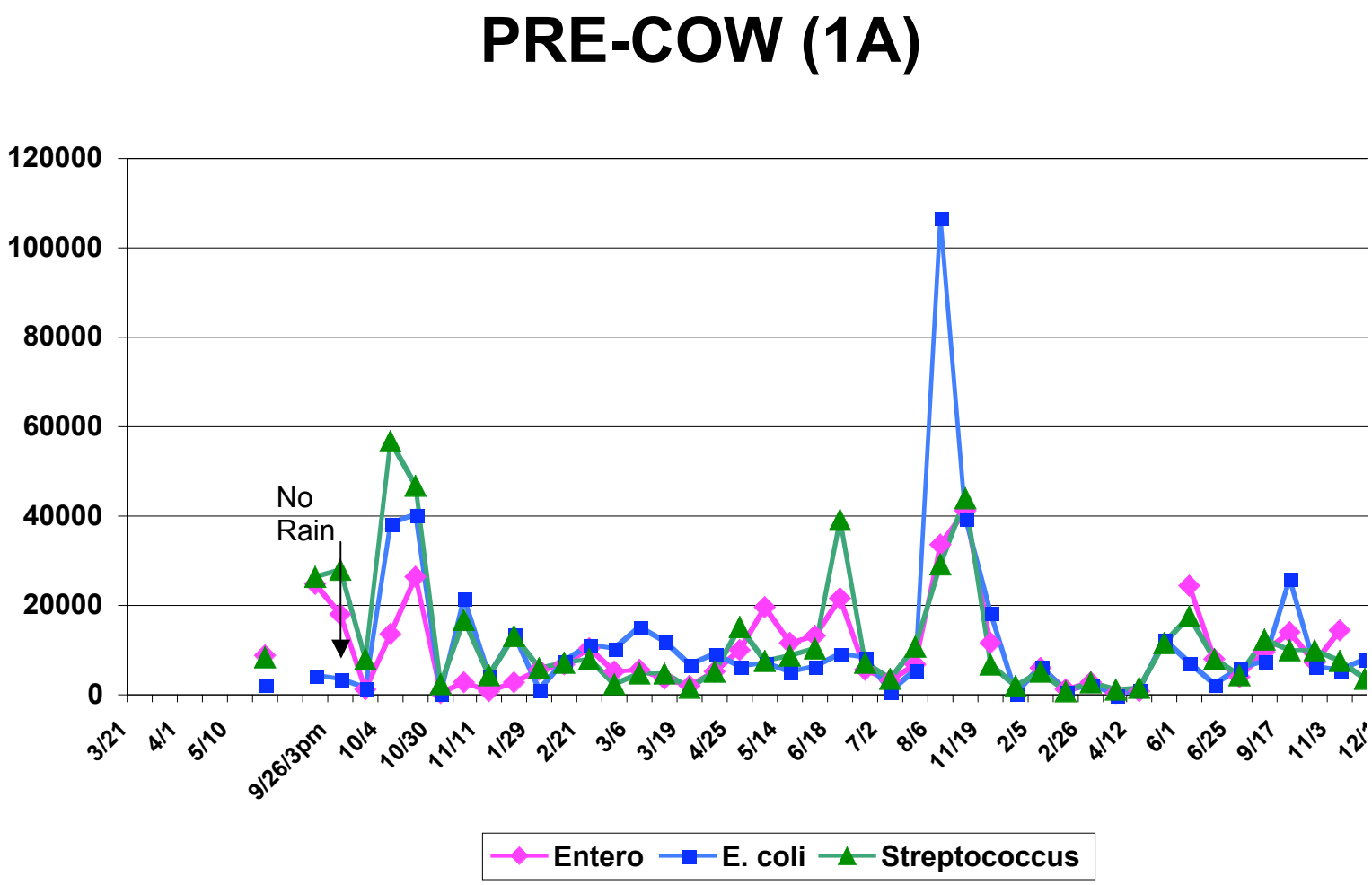

Figure 3. Graph of bacteria from a water sample collected from runoff from a grazing area of approximately 125 acres that has a variable stocking rate. Bacteria are reported as counts/ml of water.

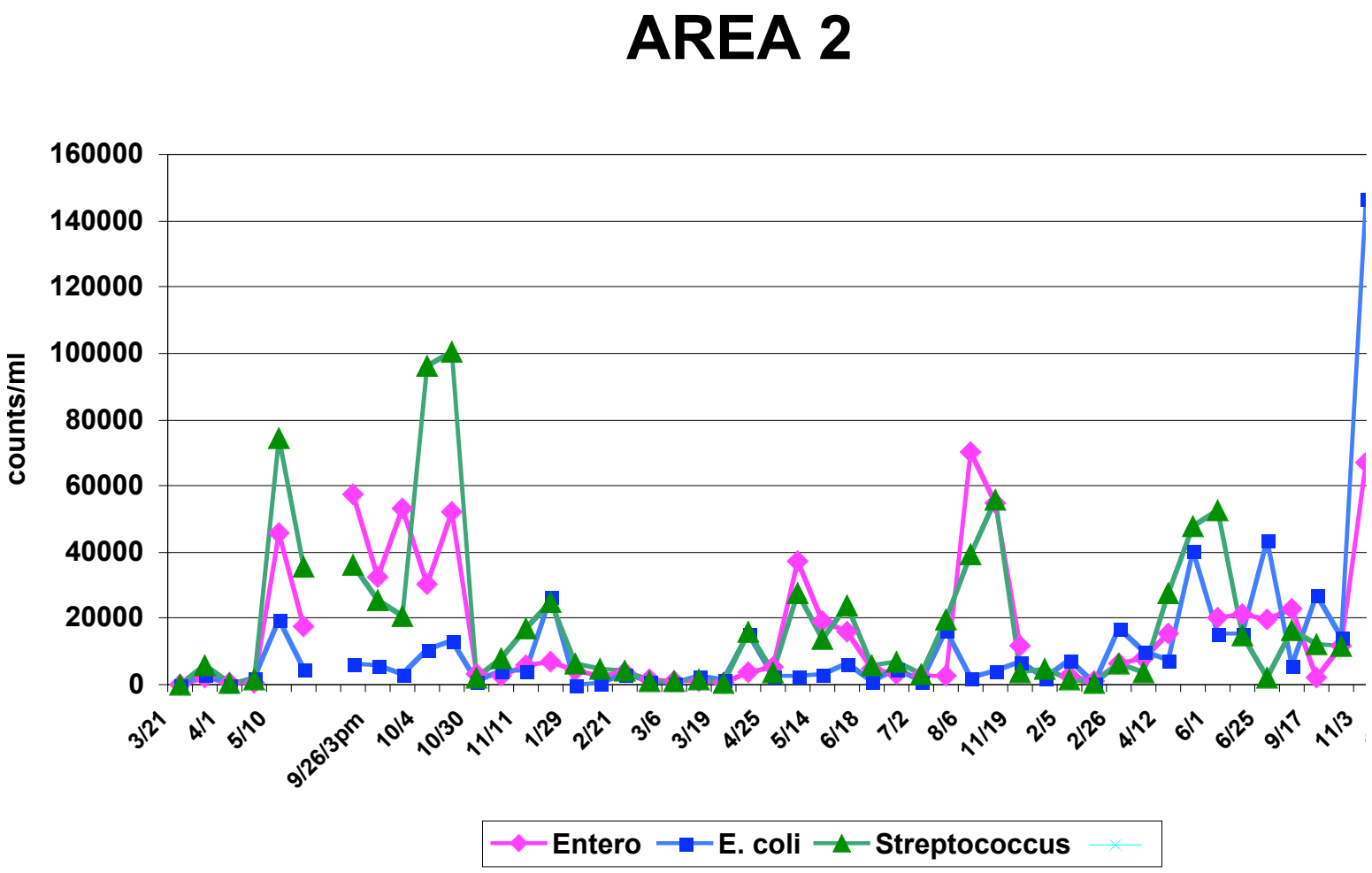

Figure 4. Graph of bacteria collected from a runoff water sample taken from a ditch that drains a wooded and grass covered area of approximately 150 acre area inhabited by wildlife that has no human or farm animal fecal contribution.