RESULTS

Among 93 cefitoxifen-resistant E. coli obtained from 6 farms in 2002, none had blaCTX-M-1, and 82 (88.2%) had blaCTX-M-9 (Table 1). Among ceftiofur-resistant E. coli isolates from Farm 60 obtained in 2008, early and late 2011, 0/18, 0/9, and 5/18 were positive for blaCTX-M-1, respectively, while 9/18, 8/8, and 5/18 were positive for blaCTX-M-1 (Table 2). Prevalence of blaCTX-M-positive E. coli on four farms sampled in 2011 was 5.3, 30.8, 66.7, and 25.0% (Table 3). Among 30 blaCTX-M-positive E. coli, 1 had Group 1, 17 had Group 2, and 13 had Group 3. PFGE profiles of blaCTX-M-positive E. coli from a single farm indicated a clonal relationship between isolates from calves in neighboring herds, and from the same calf sampled 2 weeks apart (Fig. 1). Preliminary results from an ongoing study indicate a high prevalence of phenotypes characteristic of E. coli with both blaCMY and blaCTX-M genes on 9 farms sampled so far (Table 4).

CONCLUSIONS

Before 2010, third-generation cephalosporin resistance in gram-negative bacteria of US dairy cattle was considered to be primarily associated with AmpC enzymes coded by blaCMY. Results of our retrospective testing (Tables 1 and 2) were consistent with that view. Although E. coli isolates banked at WSU from previous studies are limited with regard to number of farms and time periods represented, these data suggest that emergence and dissemination of blaCTX-M-positive E. coli may be a recent phenomenon on Washington dairy farms. blaCTX-M-positive E. coli were detected in 2009 at a low prevalence in adult dairy cattle in Ohio and the earliest detection in calves in Washington was in 2011 in our study. On a single, large dairy from which ceftiofur-resistant isolates were available in 2008 and 2011, no evidence of blaCTX-M-positive E. coli was observed until late 2011 (Table 2). Although we cannot rule out an earlier occurrence of blaCTX-M-positive Enterobacteriaceae in Washington cattle than in human infections, the evidence supports the reverse, that human clinical infections with blaCTX-M-positive Enterobacteriaceae preceded their occurrence in livestock, possibly by several years. However, whether this represents clonal bacterial or plasmid dissemination, or independent emergence in multiple locations, is as yet unknown. Our limited PFGE results suggest that blaCTX-M-positive E. coli strains in the dairy calf environment can be transmitted between neighboring calves, and can persist in the animals for several weeks. The rapid emergence and spread of blaCTX-M-positive E. coli currently being observed in Washington dairies suggests that a shift in importance from blaCMY to blaCTX-M may be taking place in the bovine reservoir. To determine risk factors for this shift, our current sampling effort is accompanied by investigations into antibiotic use and animal movements. In addition, further molecular characterizations (plasmid replicon typing and E. coli genotyping) will provide better insights into determinants of this shift.

REFERENCES