Introduction
Manganese is an important mineral for beef cattle reproduction (Hidiroglou, M. 1979b), which is one of the most important traits in beef cattle management (Taylor and Field, 1999). Diets low in manganese have been found to have negative effects on conception rates (Hidiroglou, M. 1979b).

Even after conception, low manganese can impact embryo development (Hidiroglou, K. 1981, Hansen et al. 2006a), which makes it important to have adequate cow levels because, like selenium, manganese is transferred through the placenta to the embryo and fetus (Abdelrahman and Kincaid, 1993). If not aborted, calves born from manganese deficient cows are weak (Rao 1963) and can show signs of incoordination, skeletal deformity, and tongue tremor (Hidiroglou, M. 1979a). To our knowledge there has been no formal or broad look into manganese deficiency in California beef cattle, though the hypothesis was that manganese deficiency commonly occurs in California. To test this hypothesis, with a large research team, we sampled 43 herds from far Northern to Southern Central Coast of California. Our investigators and some local veterinarians have found deficient cases. We also collected selenium (whole blood) and trace element supplemental effectiveness over a long period of time. Serum sampling of manganese is a method to quantify deficiency as long as manganese deficiency has been prolonged and liver stores are no longer adequate (Hidiroglou, M. 1979a). Additionally, most cattle receive the same supplement throughout the growing season, thus if manganese is supplemented we would be able to ascertain supplemental effectiveness over a long period of time.

Method
As opposed to reproductive problems associated with low manganese, average daily gain has not been associated as clearly with low manganese (Hansen et al., 2006b), thus our focus on this research was on breeding age cows, rather than yearling cattle. We sampled 10 head per herd at 43 ranches (430 total; Figure 1) in California. Sampling occurred both on irrigated pasture and rangeland with the preference being toward the end of each forage sources growing season so that deficiencies would have the most time to express themselves if manganese levels differed. Even with the same supplement throughout the growing season, it is still possible for deficiencies to occur both on irrigated pasture and rangeland with the preference being toward the end of each forage sources growing season so that deficiencies would have the most time to express themselves if manganese levels differed.

Results
Manganese deficiency found in most beef cattle serum samples

Survey of California beef cattle mineral status
Manganese deficiency found in most beef cattle serum samples

Table 1. Adequate reference ranges for Se, Cu, Z, and Mn

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Selenium, ppm</th>
<th>Copper, ppm</th>
<th>Zinc, ppm</th>
<th>Manganese, ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ref. Range</td>
<td>0.08-0.5</td>
<td>0.8-1.5</td>
<td>0.8-1.4</td>
<td>6-70</td>
</tr>
</tbody>
</table>

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