



Earth Current Research Update

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More information available at:
www.uwex.edu/uwmrii



Minnesota Science Advisors Earth Current Study

Commissioned by the Minnesota State
Legislature

Convened a Panel of 9 Technical
Experts
The Science Advisors



Minnesota Field Study

- Step Potential (Mainly from local sources)
 - Barnyard 1 - 50 mV
 - Field 0 - 11 mV
 - Stall 1 - 30 mV average (3-150 mV Maximum)
- Further study of earth currents from distant sources cannot be justified
- Physiological effects of small step potentials being investigated



Minnesota / Wisconsin Opinion Survey

- Conducted by USDA Agricultural Statistics service
- Random sample of 1300 farms
- Electrical exposures listed in bottom 1/3 of 26 animal health and production concerns
- <2% of farms had unresolved health issues believed to be due to electrical exposures

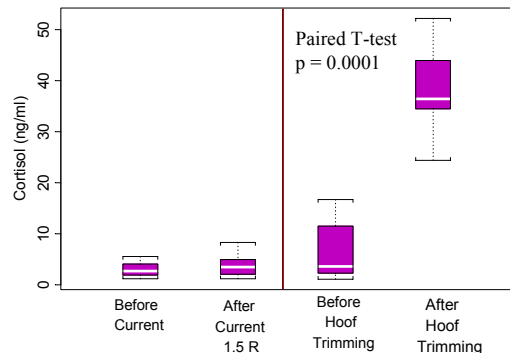


Minnesota Science Advisors Ground Current Study: The Hypothesis

- Continuous contact of confined cows to low level (sub perception) voltage/current may produce,
- Electric fields inside the cow at levels high enough to produce Biological effects



No Cortisol response for current exposure
Big Cortisol response for hoof trimming



No response to current Some response for broken milking machine

	Pulsation Failure	1 mA current exposure
Milk Yield (kg)	1.19 *	0.13
Average Flow Rate (kg/min)	0.24 *	0.15
Maximum Flow Rate (kg/min)	0.29 *	0.04
Activity (weight shifts / milking)	-5.84 ***	-1.28
Strip Yield (% of quarters > 10 ml)	-0.10	0.09

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Conclusions

- No difference between control and treatment cows for any of the 3 main response variables
- Statistically significant difference for 1 of 10 of the secondary response variables
 - But did not appear to be consistent with other observations
- Collectively, these results suggest that exposure to 1 ma of current for two weeks had no significant effect on the immune function of dairy cattle.

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Findings of the Minnesota Science Advisors

We have not found credible scientific evidence to verify the specific claim that currents in the earth or associated electrical parameters such as voltages, magnetic fields and electric fields, are causes of poor health and milk production in dairy herds

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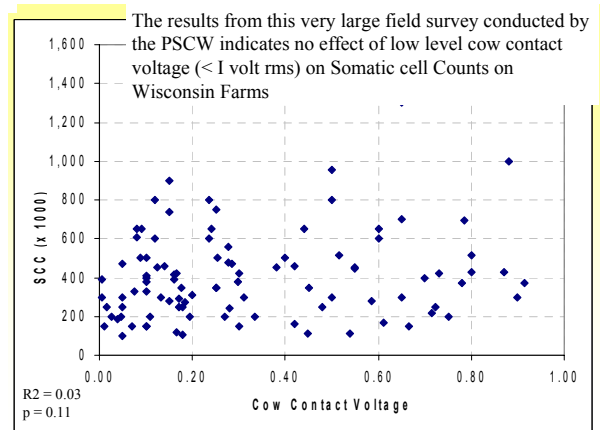
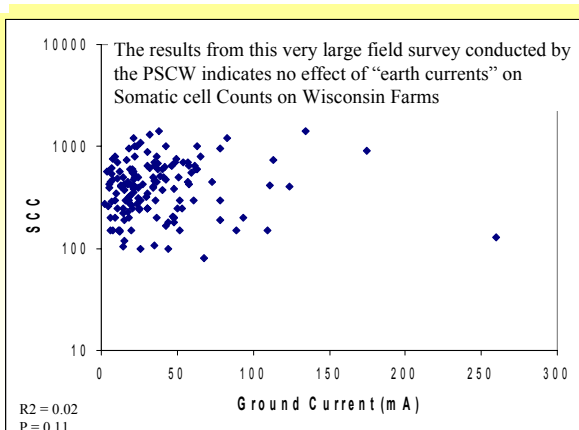
Wisconsin Field Study

6000+ Farms

No Correlation Between Milk Production or Somatic Cell Count and

- Primary NEV
- Secondary NEV
- Cow Contact Voltage
- Ground Rod Current

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Electric and Magnetic Field Research at McGill University

Javier Burchard, DVM, PhD
Department of Animal Science
McGill University



Study Origins and Design

- 🐮 Study to address concerns over construction of a 735 kV transmission line in Quebec
- 🐮 Physiological, Health and Production effects on dairy cows
- 🐮 Worst Case Exposure
 - 🐮 10 kV/m
 - 🐮 30 microTesla



Seven Experiments 113 Cows General Conclusions

- 🐮 Extreme level and duration of EMF exposure produced some physiological changes
- 🐮 Similar to changes in day length
- 🐮 Changes were within the normal range for healthy cattle.
- 🐮 These changes do not represent a health hazard



Studies of Human Electrical "Hypersensitivity" (EHS)

- 🐮 Report Issued by IEEE - COMAR
 - 🐮 Inst. Of Electrical and Electronic Engineers -Committee on Man and Radiation
- 🐮 Claims of symptoms to EMF far below recommended exposure limits
 - 🐮 very far below levels known to produce adverse effects
- 🐮 At least 9 provocation studies reported
 - 🐮 Overwhelmingly unsuccessful in linking EHS symptoms to EMF exposures
- 🐮 No scientific basis currently exists for a connection between EHS and exposure to EMF



Wisconsin Earth Currents Study

Commissioned by the Wisconsin State Legislature
Assigned to the UW College of Ag and Life Sciences



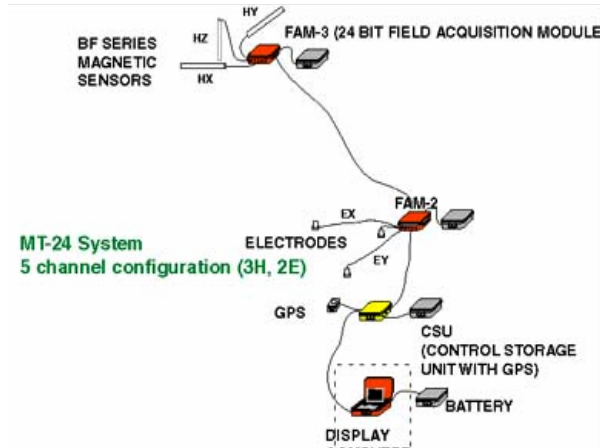
Origins of the Study

- 🐮 (DATCP) budget proposal for additional stray voltage research
- 🐮 Governor signed budget bill with partial vetoes
 - 🐮 language requiring research of 3rd harmonic currents on human and animal health.
 - 🐮 DHFS is not the appropriate agency
 - 🐮 Removed language mandating how UW should conduct the research
- 🐮 Dean Aberle met with the Rural Energy Management Council
- 🐮 RFP issued to UW System
- 🐮 Proposal Submitted
- 🐮 REMC invited public comment on the research proposal
- 🐮 REMC committee review public comments and submitted recommendations
- 🐮 Project funded after full consideration of
 - 🐮 UW faculty reviews
 - 🐮 REMC recommendations
 - 🐮 Response from the research team

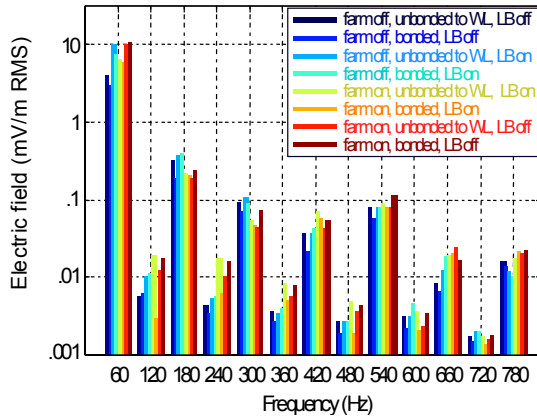


Earth Current Determination using the Remote-Reference Magnetotelluric Method

Dr. David L. Alumbaugh
 Geological Engineering Program
 Dept. Civil & Environmental Engineering
 UW Madison



Total Efield for Newell site 203



Earth Currents

- current densities at farms ranged from about 5 to 50 $\mu\text{A}/\text{m}^2$
- 10-1000 times stronger than remote sites
- The resulting step potentials 260 to 8300 below PSCW level of concern.
- Step potentials resulting from earth currents less than 2% of the PSCW level of concern.



Gene expression to Assess Potential impacts of low level contact voltage (current) on dairy cattle

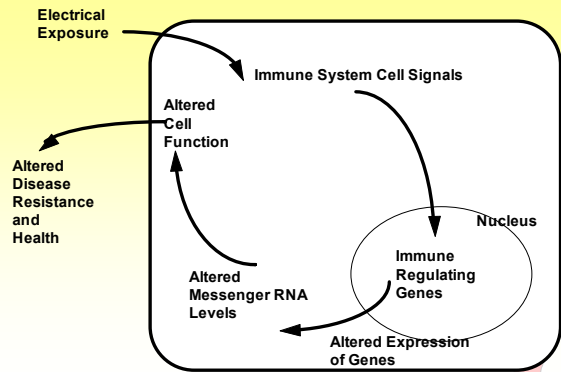
Prof. Lewis Sheffield
 UW Dairy Science Department



Gene Expression

- Environmental factors signal the cow to turn on or off various genes.
- Genes produce varying amounts of messenger RNA.





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Array Hybridization

- 🐾 New method in biology
- 🐾 Allows assessment of large numbers of genes
- 🐾 We will analyze 12,000 types of gene expression



New Exposure Method

- 🐾 Current Generator mounted on cow
- 🐾 Programmable Waveform (up to 20 mA)
- 🐾 Current injected diagonally across hooves
- 🐾 Continuous Monitoring of current levels
- 🐾 1 mA with typical 'earth current' waveform.
- 🐾 3 weeks exposure



Results

- 🐾 Milk production was unaffected by current exposure
 - 🐾 (66.4 ± 1.2 vs 65.9 ± 0.9 lbs/day in control and exposed, respectively).
- 🐾 Behavior of the cows was not noticeably affected.
- 🐾 Negative control genes were undetectable, as was expected



Results

Most measures (11,996 out of 12,000) were not affected
 A small subset of immune system regulators showed possible changes:
 Could be Type I errors, due to the large number of hypotheses tested.
 The magnitude of effect was relatively small, compared to that often observed in the literature in response to major immune system challenges



Conclusions

- 🐾 Any possible impacts of electrical exposure on immune function are of relatively small
- 🐾 Possible responses were only a small subset of immune system regulators (0.03%)
 - 🐾 most disease processes affect a wider spectrum of regulators
- 🐾 Impacts of electrical exposure on animal health and disease is likely to be difficult to detect

