

# Environmental Persistence of Brucella in the Greater Yellowstone Area

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## Cooperators:

Mt. Dept. Fish, Wildlife and Parks  
National Park Service-Yellowstone National Park  
USDA/APHIS/Veterinary Services  
USGS/Biological Resources Division  
US Forest Service  
Montana Department of Livestock  
Munz Family  
Royal Teton Ranch



# Three Related Study Elements



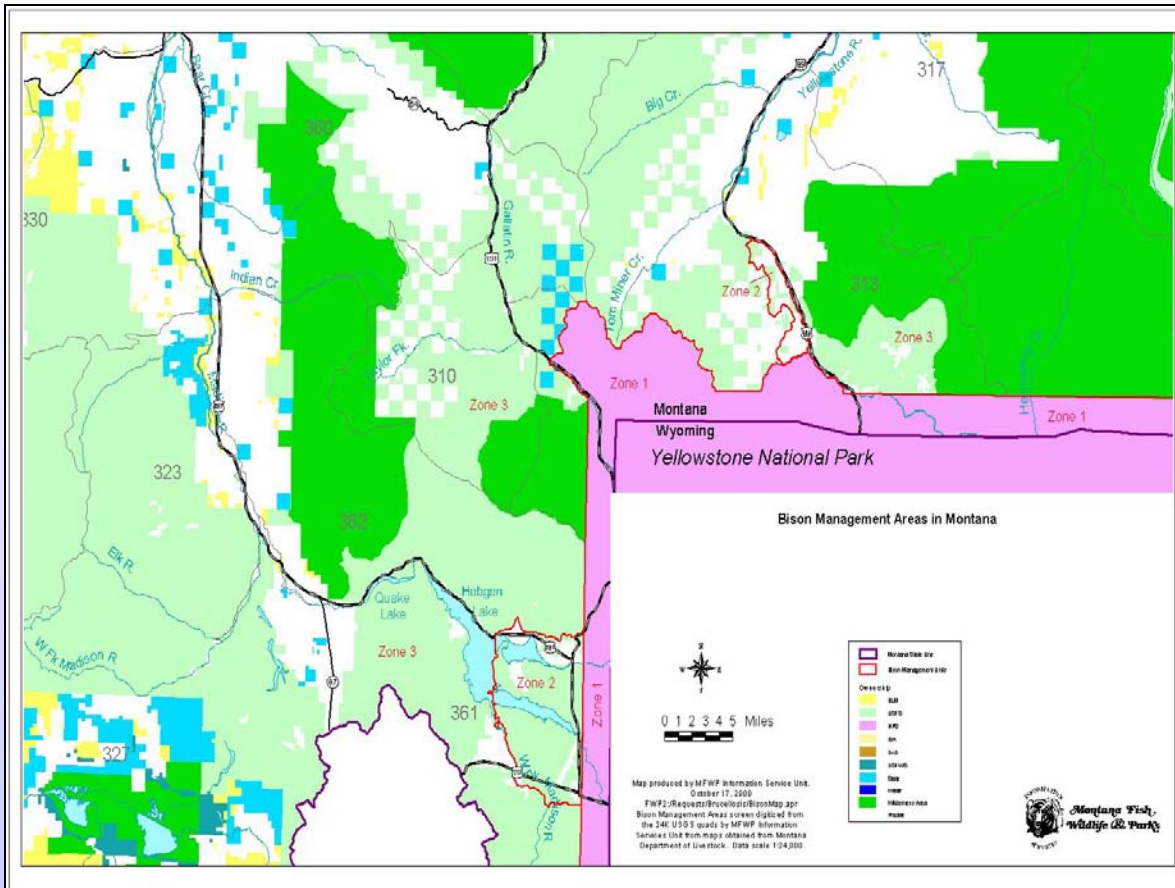
- Persistence of RB51 in fetal tissues under natural conditions typical of the Greater Yellowstone Area
- Disappearance of fetuses due to scavenging or natural decomposition in the Greater Yellowstone Area
- Persistence of field strain B. abortus in abortion or birth events in the Greater Yellowstone Area

# RB 51 Persistence and Fetal Disappearance Study



- Study was developed as a result of the Interagency Bison Management Plan record of decision signed in December, 2000.
- The bison plan recommends this research to provide accurate scientific data for determining the appropriate temporal separation period for bison and cattle in the Greater Yellowstone Area.
- First year study design was a pilot effort to explore field methodologies. The second and third years implemented these methodologies.
- Objectives of the study are:
  - Using RB51 strain brucella- model the persistence of the bacteria on fetal tissues
  - Using appropriately placed bison fetuses from slaughter plants-model field abortions and establish the time period before they are naturally scavenged in the environments adjacent to Yellowstone National Park.

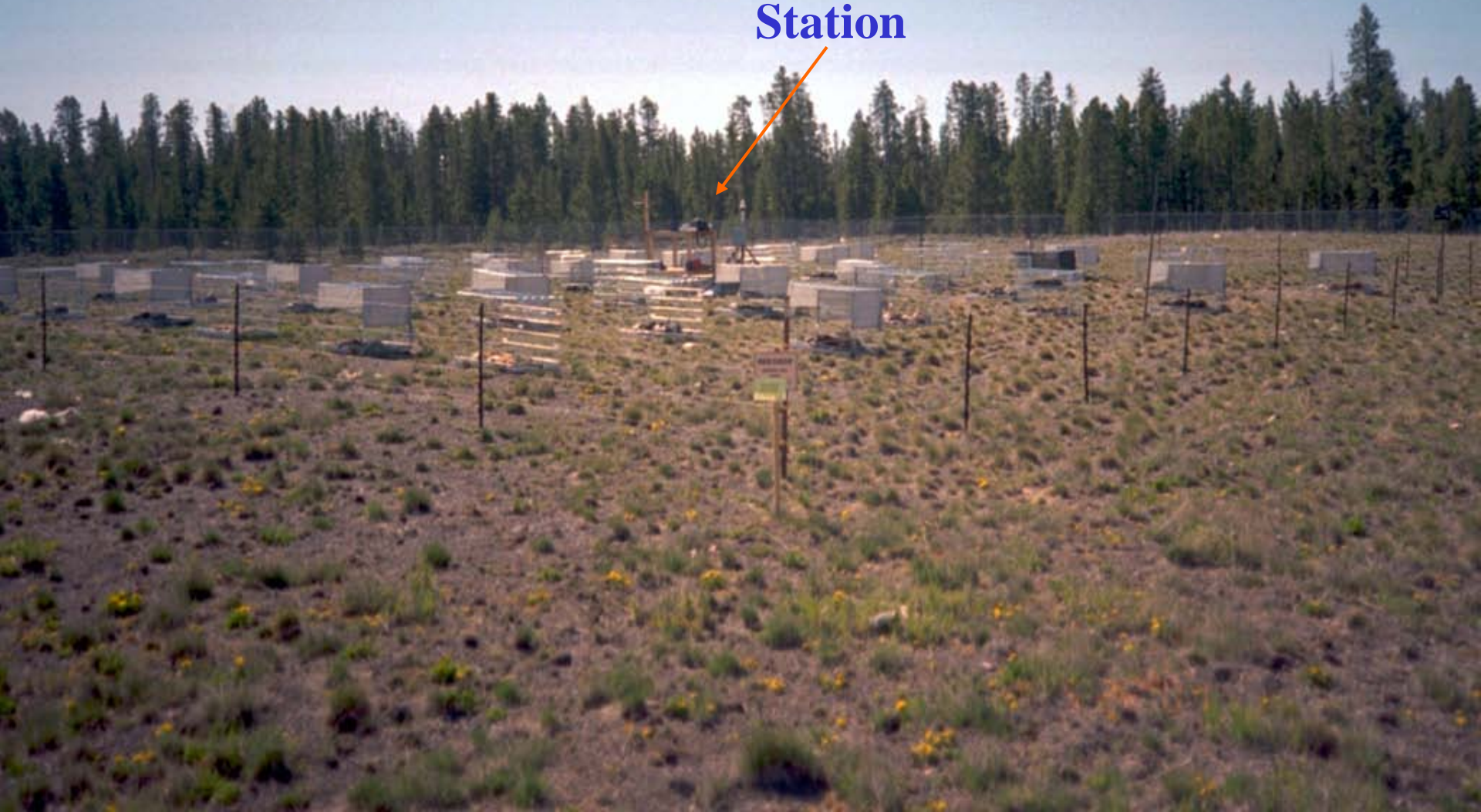
# Study Areas



- Two study sites were selected-Gardiner and West Yellowstone as points of exodus for migrating bison from YNP.
- Each has unique environmental conditions that could contribute to differences in the survival of the bacteria *Brucella abortus*.

# RB51 Persistence Study Site-West Yellowstone

**UV-Weather  
Station**

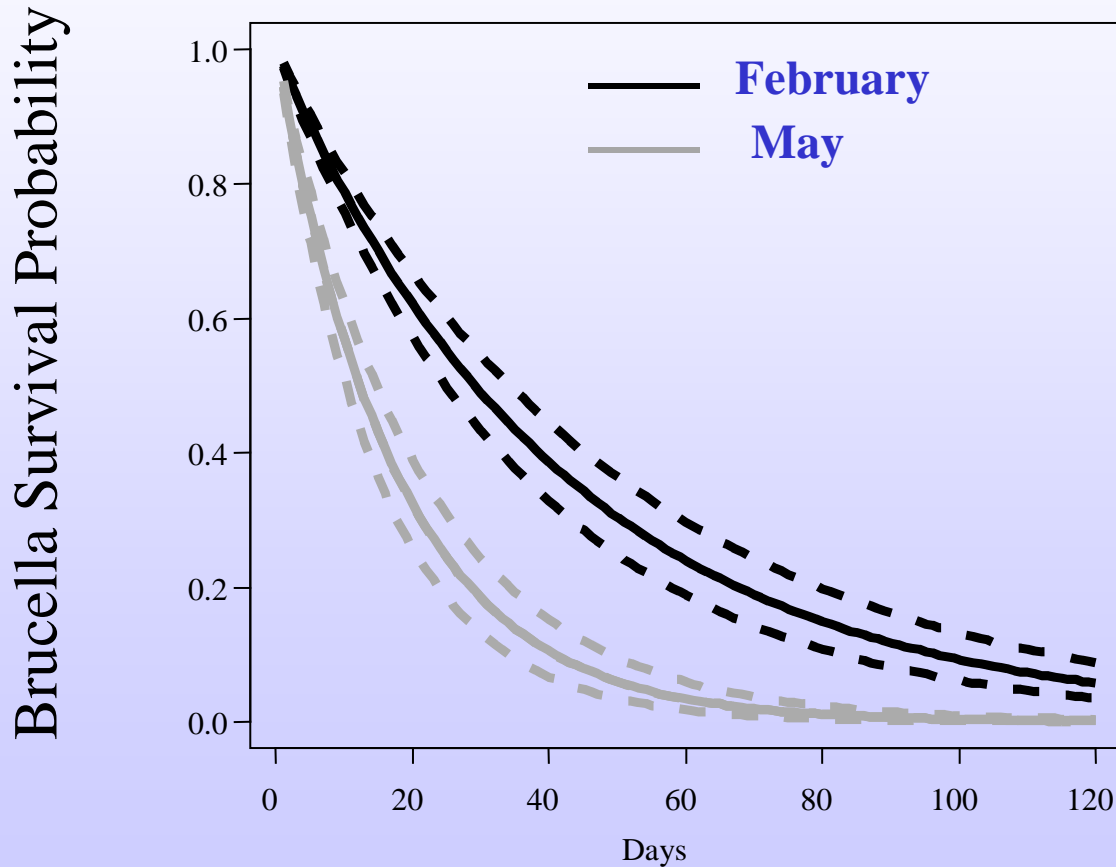


# RB51 Persistence Study Site-Gardiner, Montana





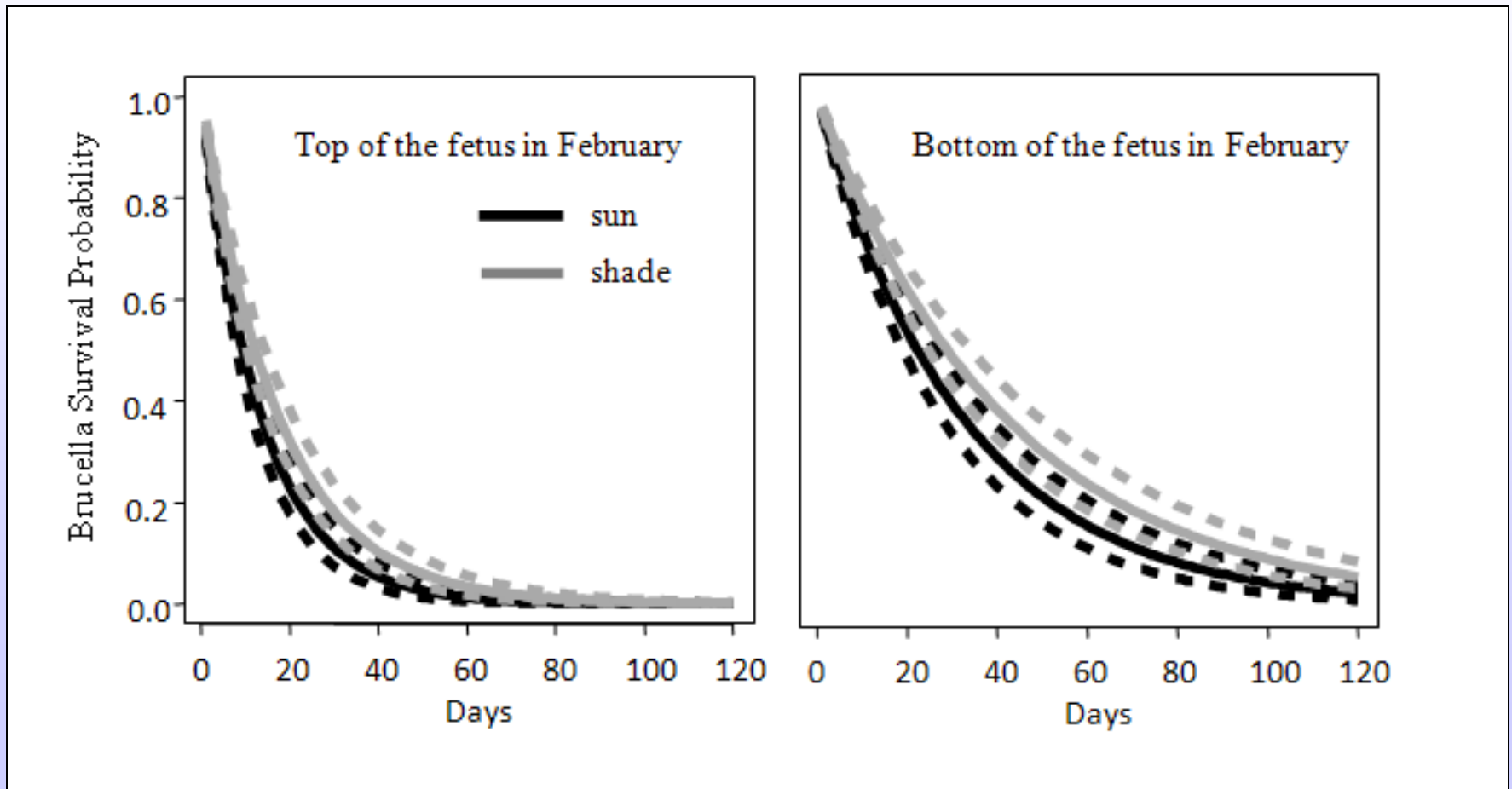
# Cox Proportional Hazards Model of Persistence of RB51 In Shade-Feb and May





# Cox Proportional Hazards Model for Persistence of RB51

Top Versus Bottom of Fetus



# Maximum Length of Brucella Survival by Month of Deployment

		TOP		BOTTOM		SWAB	
		Observed	Predicted	Observed	Predicted	Observed	Predicted
Month	N	Max. Days	Median (95%CI)	Max. Days	Median (95%CI)	Max. Days	Median (95%CI)
Feb.	96	67	12 (10-15)	77	24 (29-34)	81	22 (19-26)
Mar.	96	49	15 (13-17)	77	33 (38-39)	63	26 (21-30)
April	96	42	11 (10-13)	69	26 (21-30)	44	20 (17-24)
May	88	21	6 (5-7)	24	13 (11-15)	25	10 (8-12)

# Fetal Disappearance Study 2001

## Gardiner and West Yellowstone



- We deployed 94 fetuses at two study sites. Sets of 16 fetuses were set out in March, April and May 2001.
- 61 were placed on a 1 km. grid within YNP near Gardiner and West Yellowstone in 2001.
  - 33 were placed on private land in an optimal grid pattern maintaining 0.5 km spacing- Munz (West) and RTR (Gardiner).
- Approximately half were monitored with motion sensing cameras equally distributed among stations.
- Carcasses were fitted with small transmitters to track movement upon scavenging.

# Fetal Disappearance Study 2002-03

## Gardiner and West Yellowstone



- We deployed 88 fetuses in 2002 and 84 fetuses in 2003, March April and May.
- Carcasses were placed out 4 per week
- Sites were outside YNP and were selected with a stratified random process
  - At elevations and in habitats used by radio collared bison 1995-2000.
- Placed out in-utero with fluids and membranes.
- Fitted with transmitters.
- Data on the presence or absence of bison and other wildlife were recorded upon deployment.

# Scavengers Identified



**Mountain  
Lion**

- Coyotes
- Fox
- Bears
- Wolves
- Mtn. Lion
- Ravens
- Eagles
- Turkey Vulture
- Magpie
- Hawks
- Skunk
- Marten

# Scavenging Activity Notes



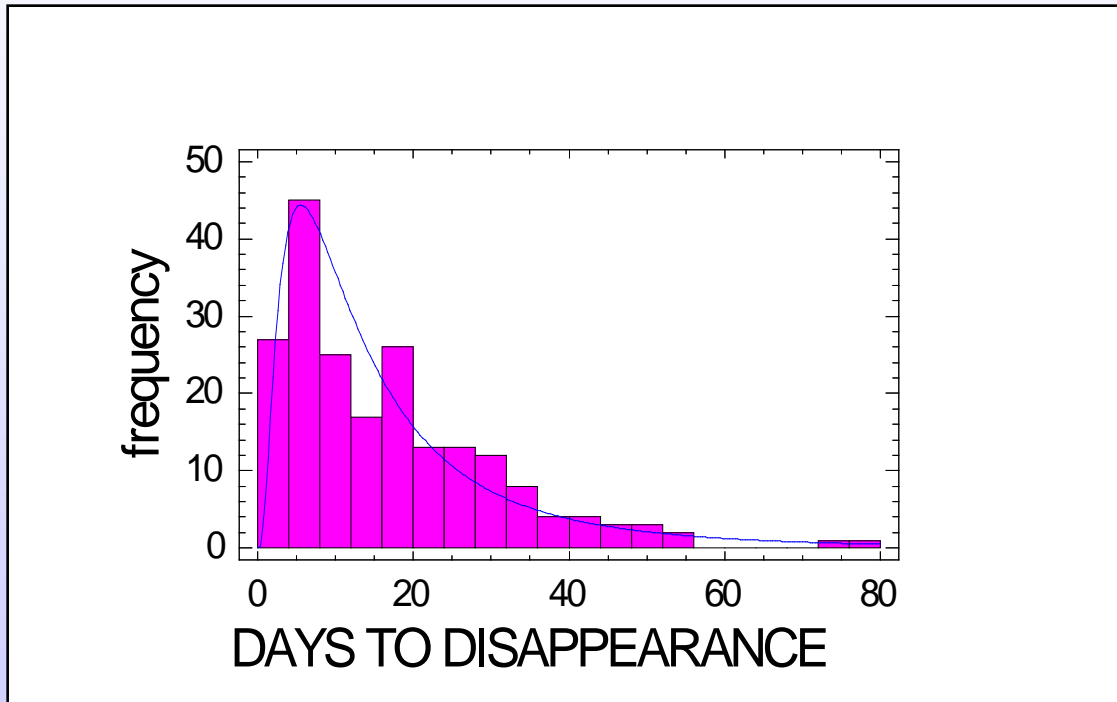
- Transmitters indicated scavengers carried off portions of carcasses.
  - 106/204 (51.9%) moved at least 100 feet from deployment site.
  - Max Distance moved was 2 miles
  - One moved on Hebgen Lake Ice
  - One went across Hebgen Lake
  - Movement was detected between public and private land
- Portions of carcasses were cached.
  - In trees
  - Buried in soil
  - In Dens
- Most of the scavenging by mammals was at evening or night while birds scavenged during the daylight hours.

# Other Species Interacting with Fetuses



- Bison commonly investigated sites and frequently made physical contact with fetuses.
- Other species coming into close contact with fetuses include:
  - Elk
  - Mule Deer
  - Antelope
  - Jack Rabbits
  - Canada Geese

# Distribution of the Days to Disappearance Data Outside YNP 2002-2003



- N=204
- Range 1-78
- Mean 18.23
- S.D.=20.1
- Outliers represent fetuses not scavenged but decomposing on north boundary

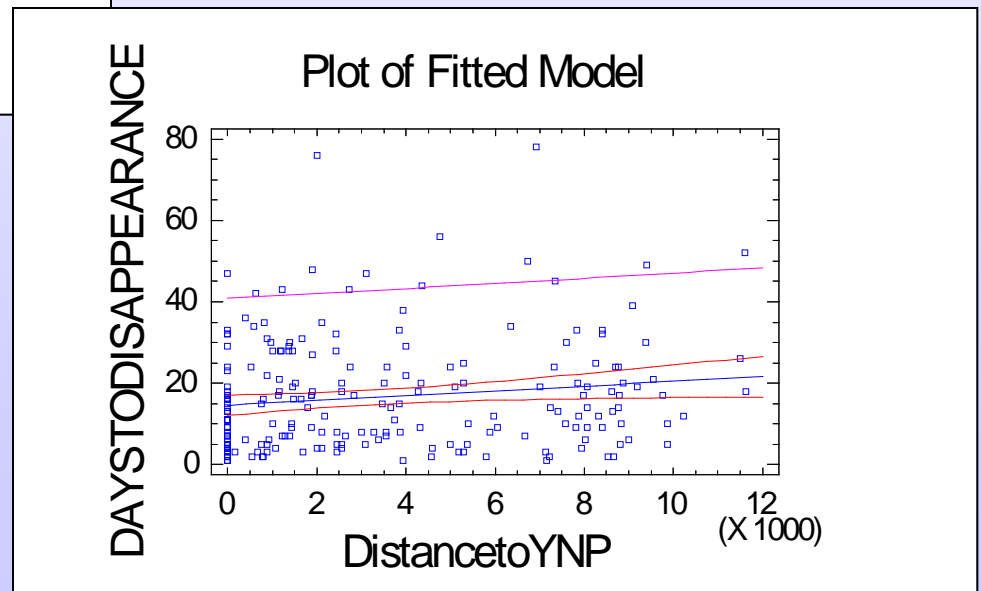
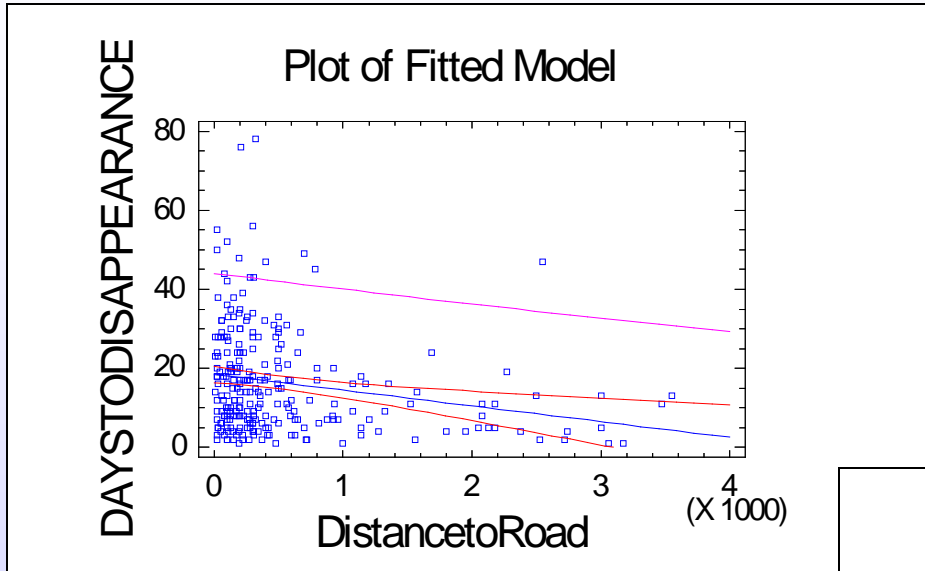


The maximum number of days that a fetus remained on the landscape and the latest date until it was completely scavenged outside of YNP.

Month	2001			2002			2003			All Years		
	N	Max.	Date	N	Max.	Date	N	Max.	Date	N	Max.	Date
March	5	47	<u>4/26</u>	16	78	<u>5/5</u>	16	55	<u>4/15</u>	37	78	<u>5/5</u>
April	4	43	<u>5/6</u>	20	48	<u>6/4</u>	20	52	<u>6/2</u>	44	52	<u>6/4</u>
May	5	29	<u>6/7</u>	8	19	<u>5/28</u>	8	29	<u>6/4</u>	21	29	<u>6/7</u>

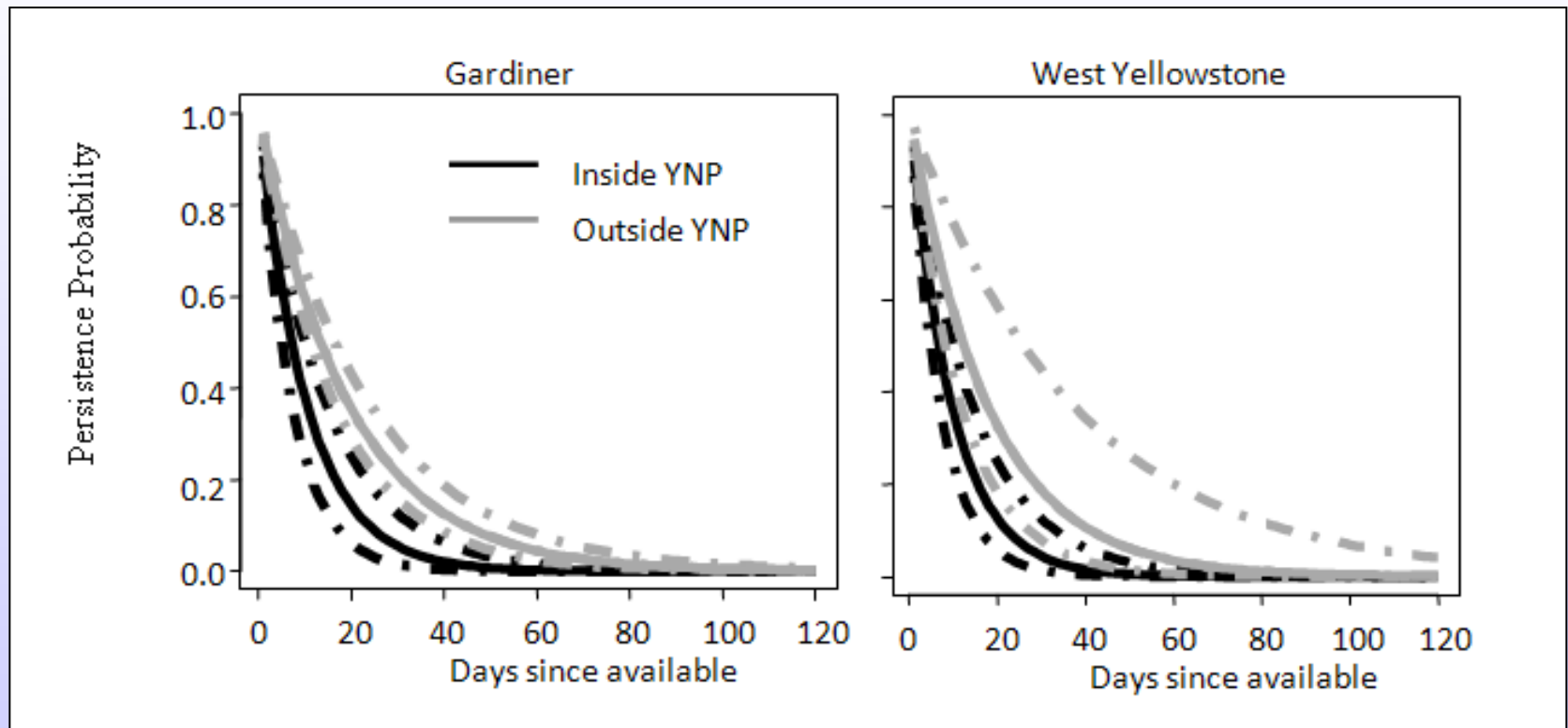
# Disappearance Data

## Regressions Against Roads and YNP

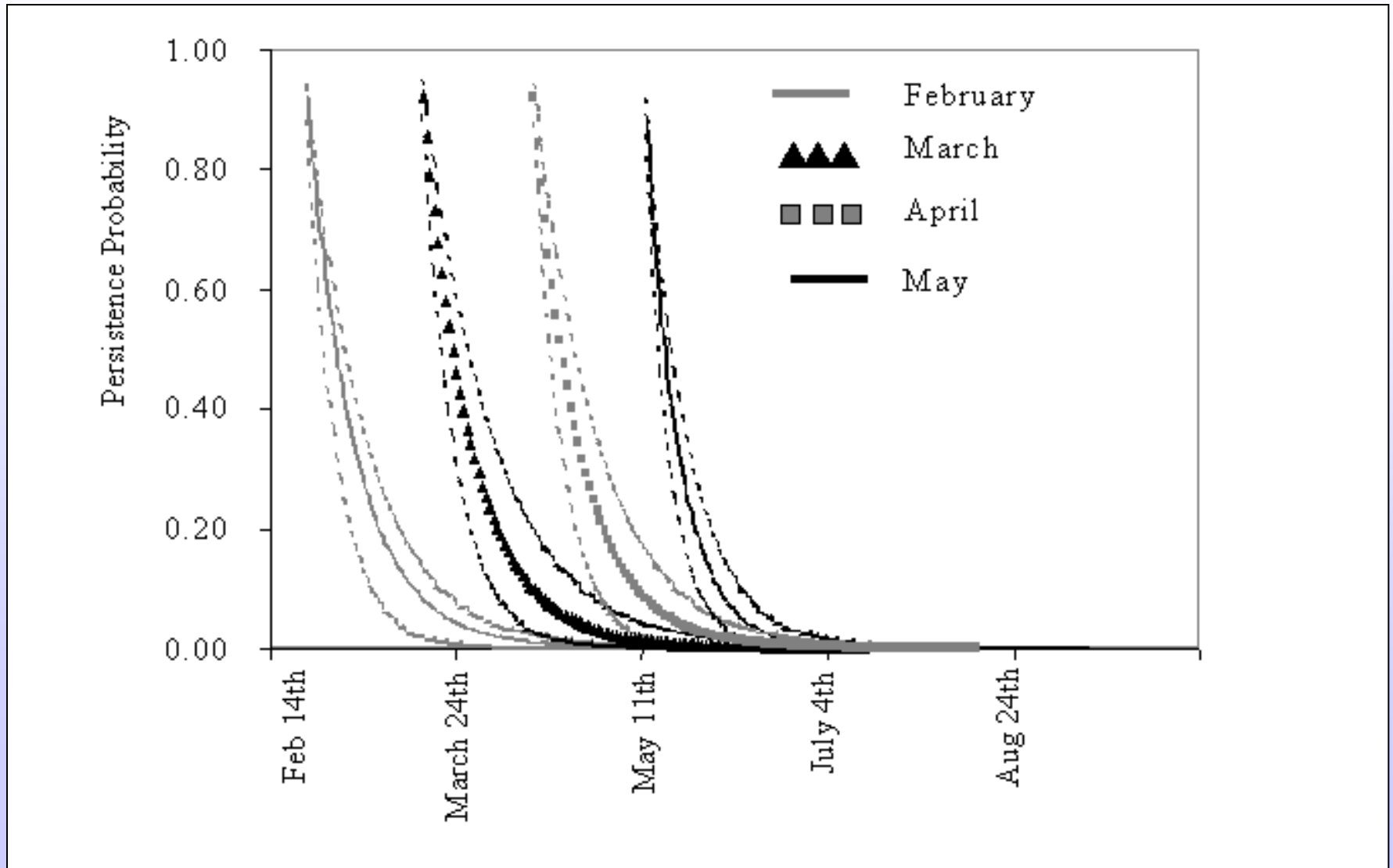


# Model for Fetal Disappearance

## Inside and Outside of YNP



# Combined Model for Disappearance and Persistence



# Characteristics of 152 Birth-Site Investigations

Implant	Chance	Birth Ejection		Unmarked	Marked	Sero-status Marked	
						Pos	Neg
75	77	96	56	64	88	33	55
49.3%	50.7%	63.2%	36.8%	42.1%	57.9%	37.5%	62.5%

# Year and month that birth or abortion sites were investigated 1996-2002.

Year	1996	1997	1998	1999	2000	2001	2002	<b><u>Total</u></b>
Feb	0	0	0	1	0	0	0	<b><u>1</u></b>
Mar	0	1	0	3	1	2	0	<b><u>7</u></b>
Apr	1	2	5	11	7	19	5	<b><u>50</u></b>
May	5	8	11	13	10	12	12	<b><u>71</u></b>
June	0	5	2	1	2	6	2	<b><u>18</u></b>
July	0	0	4	1	0	0	0	<b><u>5</u></b>
TOTAL	6	16	22	30	20	39	19	<b><u>152</u></b>

# Culture Positive Sites 1996-2002



- 14 of 152 were positive for *B. abortus* BV1 (9.2%)
  - 2 of 56 ejection sites (3.6%)
  - 12 of 96 birth-sites (12.5%)
- A fetus was located on 6 of 12 birth-sites.
- Tissues, soil or vegetation were found to be positive depending upon sites.
- All cultures were *Brucella abortus* biovar 1

# Persistence of Brucella at Field Sites



- Persistence was determined for 9 of 14 positive birth-sites.
  - 5 Other sites were sampled only one time for various reasons.
  - These sites were lost due to rain, snow, floods, or trampling,
- April Sites (N=6)
  - Persisted from 10-43 days
- May Sites (N=3)
  - Persistence from 7-26 days



# Conclusions

- **Using RB51 as a surrogate for field strain we found that Brucella can persist on fetal tissue exposed to natural conditions in the GYA.**
  - RB51 persisted longer on the bottom of fetuses and those protected by shade
  - The length of time that RB51 persisted decreased from February through May.
  - RB51 in tissues placed out in mid-May did not persist very long (25 days)
  - None of the RB51 laced fetuses in this study were culture positive after June 15.
- **Scavenging resulted in the rapid removal of most fetuses**
  - Fetuses were scavenged more quickly inside YNP than outside
  - Almost all Fetuses were scavenged within 40 days
  - However, some fetuses were not scavenged at all and naturally decomposed.
- **The Combined model predicts only a 5% chance that the bacteria or fetus persists in the landscape after 26 days in May events**
- **Soil/vegetation/tissue at birth or abortion sites naturally infected with field strain remain infected for up to 43 days in April and 26 days in May.**
  - Although sample size is small birth-sites mimics persistence data for RB51.
- **Evidence from these studies indicates that after May 15 (bison haze-back date in the IBMP), natural environmental conditions and scavenging conspire to rapidly kill or remove brucella from the environment .**

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## American Bison

Status Survey and Conservation Guidelines 2010

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**A REVIEW OF BEST PRACTICES AND  
PRINCIPLES FOR BISON DISEASE ISSUES:  
Greater Yellowstone and Wood Buffalo Areas**



By John S. Nishi