APPENDIX F

SUPPLEMENTAL FIGURES

DEVELOPMENT OF EMISSIONS-ESTIMATING METHODOLOGIES FOR DAIRY AND SWINE LAGOONS

APPENDIX F – SUPPLEMENTAL FIGURES

Section **Page**

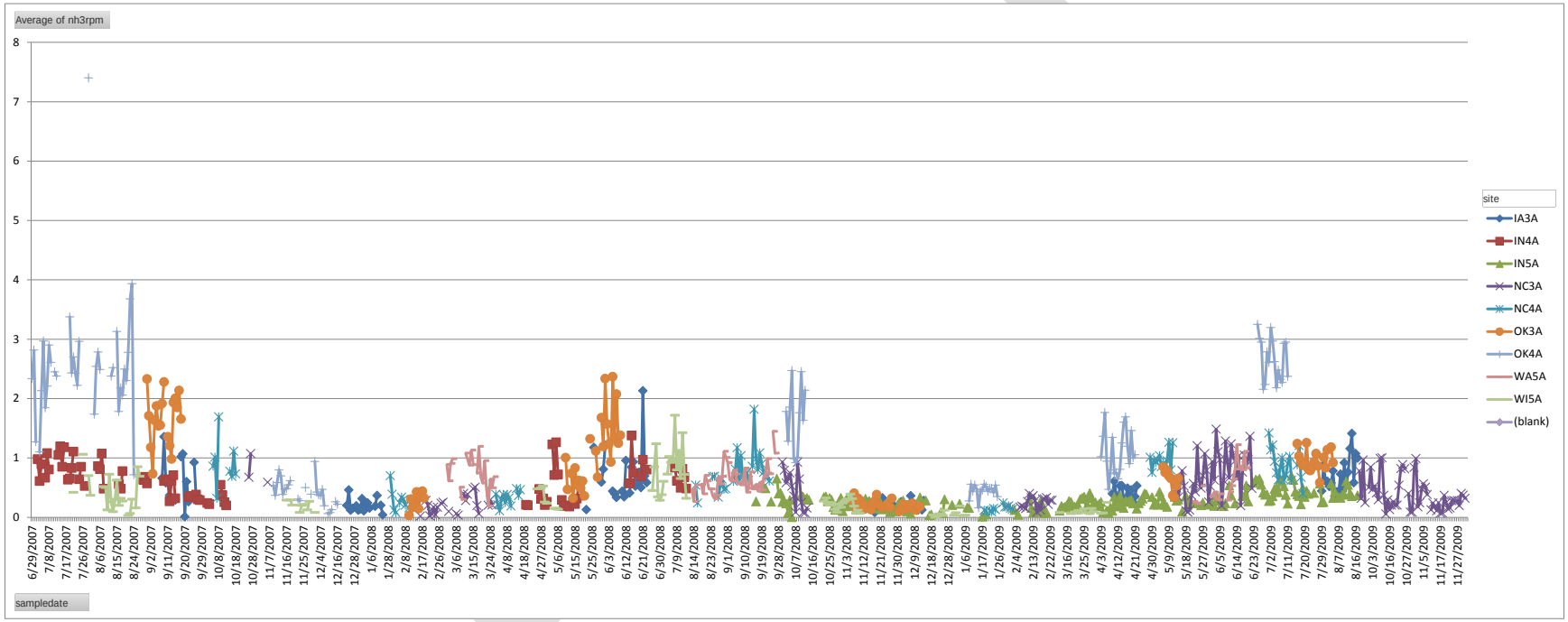
1.0 Supplemental Plots to Support NH_3 EEM Development Decisions

The figures and tables included in this Appendix were used to inform decision on which variables to include in EEMs as predictive parameters and their functional forms. Final decisions are presented in Section 5 of the main document.

1.1 NH_3 Emissions

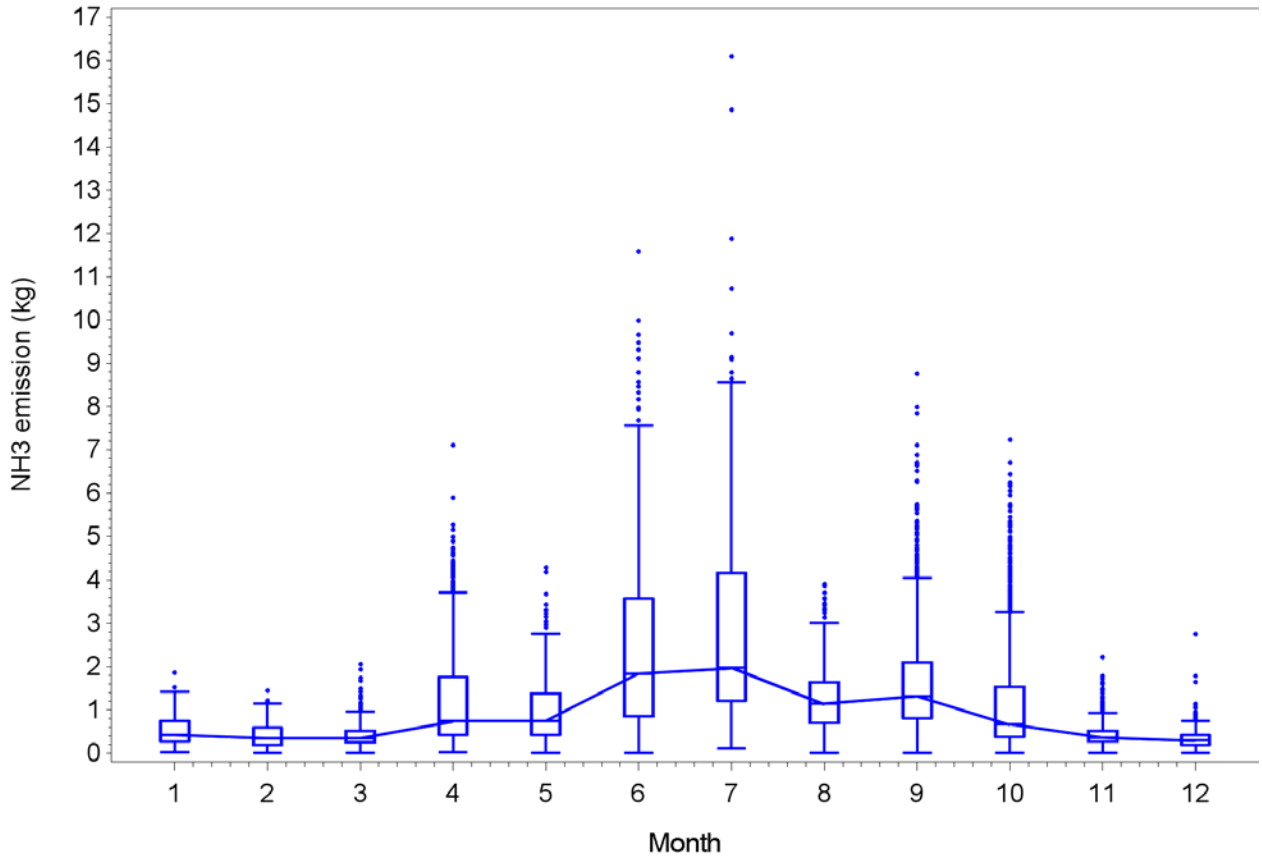
1.1.1 By Calendar date

Plot depicting the daily average NH_3 emissions based on all valid half hour averages over the duration of the NAEMS. This plot does not take into account the 75% completeness data quality objective for daily averages. The purpose of this figure was to allow for a visual representation of the data coverage and comparison of the emission rates from all the sites based on all the available valid half hour data.



1.1.2 By Month

Box plot of the NH_3 emissions by month. The plot shows an increase in emission over the summer months. The accompanying tables provide the counts of valid half hour measurements and the summary statistics for each month, by site.

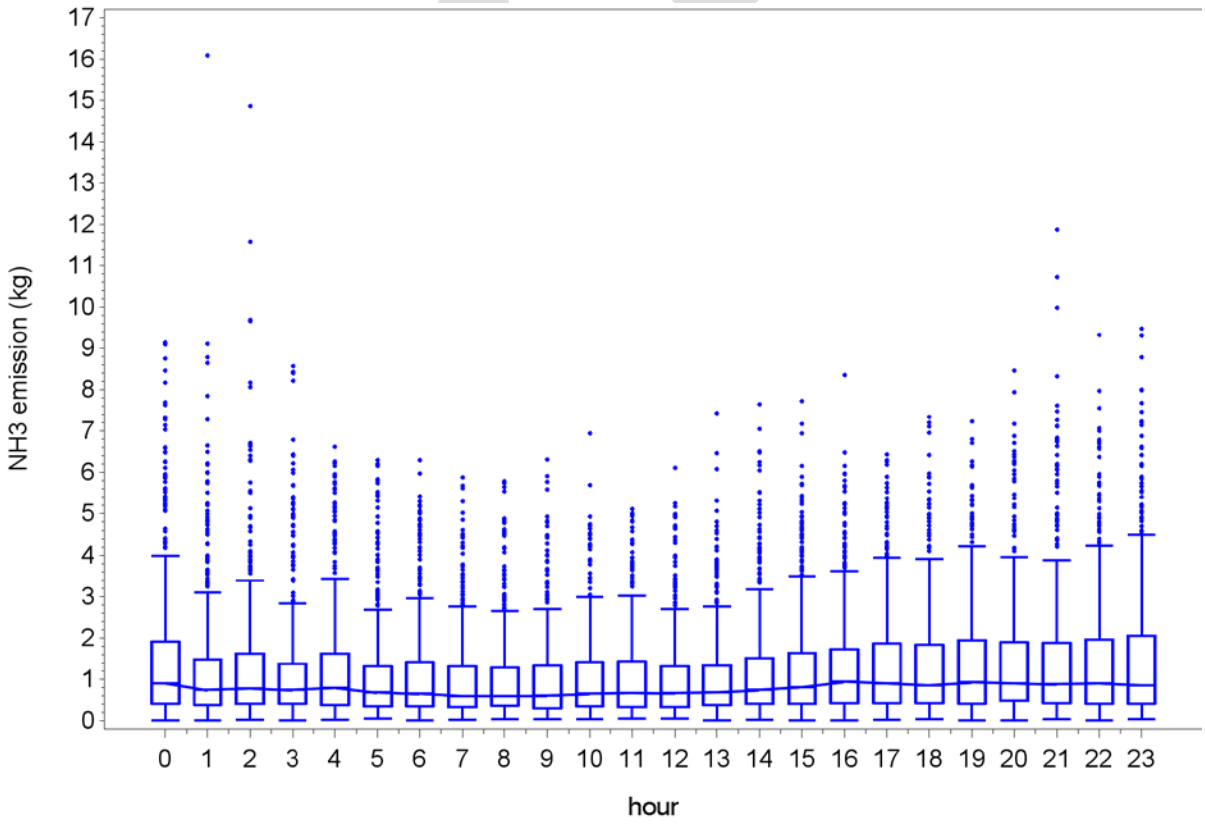


month	_LABEL_	ALL	IA3A	IN5A	NC4A	OK4A	WI5A	NC3A	OK3A	WA5A	IN4A
1	NH3 emission (kg)	182	45	17	27	90	3	.	.	.	.
2	NH3 emission (kg)	563	.	128	83	.	.	308	44	.	.
3	NH3 emission (kg)	625	.	458	.	.	34	121	.	12	.
4	NH3 emission (kg)	1381	115	471	112	569	24	.	.	.	90
5	NH3 emission (kg)	1041	34	260	248	.	8	92	246	35	118
6	NH3 emission (kg)	759	159	.	.	207	27	116	117	84	49
7	NH3 emission (kg)	1440	95	.	268	559	26	.	320	.	172
8	NH3 emission (kg)	643	359	.	51	3	15	.	43	137	35
9	NH3 emission (kg)	1264	85	89	342	.	.	8	355	239	146
10	NH3 emission (kg)	1209	.	452	62	267	97	264	.	.	67
11	NH3 emission (kg)	1284	67	607	.	64	69	158	319	.	.
12	NH3 emission (kg)	393	89	111	.	21	9	7	156	.	.

Analysis Variable : nh3 NH3 emission (kg)										
Month	N	Mean	Std Dev	Skewness	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Quartile Range
1	182	0.524	0.364	0.925	0.0180	0.270	0.414	0.738	1.854	0.468
2	563	0.403	0.274	0.827	0	0.180	0.342	0.576	1.440	0.396
3	625	0.417	0.278	1.821	0	0.234	0.342	0.522	2.052	0.288
4	1381	1.209	1.082	1.450	0.0180	0.432	0.738	1.746	7.110	1.314
5	1041	0.976	0.690	1.083	0	0.432	0.738	1.386	4.284	0.954
6	759	2.437	2.007	1.230	0	0.846	1.836	3.564	11.59	2.718
7	1440	2.717	1.936	1.289	0.108	1.206	1.971	4.167	16.09	2.961
8	643	1.255	0.728	0.882	0	0.684	1.134	1.638	3.906	0.954
9	1264	1.651	1.224	1.719	0	0.810	1.314	2.106	8.766	1.296
10	1209	1.203	1.298	1.875	0	0.378	0.666	1.530	7.236	1.152
11	1284	0.421	0.256	1.654	0	0.252	0.360	0.522	2.214	0.270
12	393	0.333	0.253	3.668	0	0.198	0.288	0.414	2.754	0.216

1.1.3 By Hour

Box plot of the NH_3 emissions by hour of the day. Does not show any strong trend in emissions over the course of the day. Patterns might be masked by the larger number of outliers (dots above the boxes). The accompanying tables provide the counts of valid half hour measurements and the summary statistics for each hour, by site.



hour	_LABEL_	ALL	IA3A	IN4A	IN5A	NC3A	NC4A	OK3A	OK4A	WA5A	WI5A
0	NH3 emission (kg)	508	44	36	124	28	60	73	94	34	15
1	NH3 emission (kg)	494	45	31	125	22	65	68	86	36	16
2	NH3 emission (kg)	452	40	26	113	20	60	58	88	37	10
3	NH3 emission (kg)	451	43	29	97	28	61	58	80	38	17
4	NH3 emission (kg)	443	48	20	108	23	52	64	88	25	15
5	NH3 emission (kg)	405	39	23	106	29	41	63	71	21	12
6	NH3 emission (kg)	380	41	15	100	23	41	67	67	16	10
7	NH3 emission (kg)	365	37	17	101	27	32	70	59	18	4
8	NH3 emission (kg)	350	37	17	95	21	27	56	72	12	13
9	NH3 emission (kg)	330	30	24	89	21	24	59	59	13	11
10	NH3 emission (kg)	317	25	21	91	16	27	52	65	12	8
11	NH3 emission (kg)	342	23	25	88	21	36	61	64	16	8
12	NH3 emission (kg)	384	35	23	94	32	45	65	66	12	12
13	NH3 emission (kg)	469	38	32	104	66	62	82	67	10	8
14	NH3 emission (kg)	484	43	29	103	86	55	79	72	10	7
15	NH3 emission (kg)	498	47	25	106	84	60	72	75	16	13
16	NH3 emission (kg)	510	56	31	109	85	60	68	71	14	16
17	NH3 emission (kg)	502	56	24	102	92	57	71	73	13	14
18	NH3 emission (kg)	500	55	34	115	75	53	74	65	14	15
19	NH3 emission (kg)	503	59	35	109	71	52	74	67	19	17
20	NH3 emission (kg)	535	54	41	125	58	56	69	76	34	22
21	NH3 emission (kg)	545	61	36	127	62	60	66	81	34	18
22	NH3 emission (kg)	511	48	44	136	45	49	60	83	27	19
23	NH3 emission (kg)	506	44	39	126	39	58	71	91	26	12

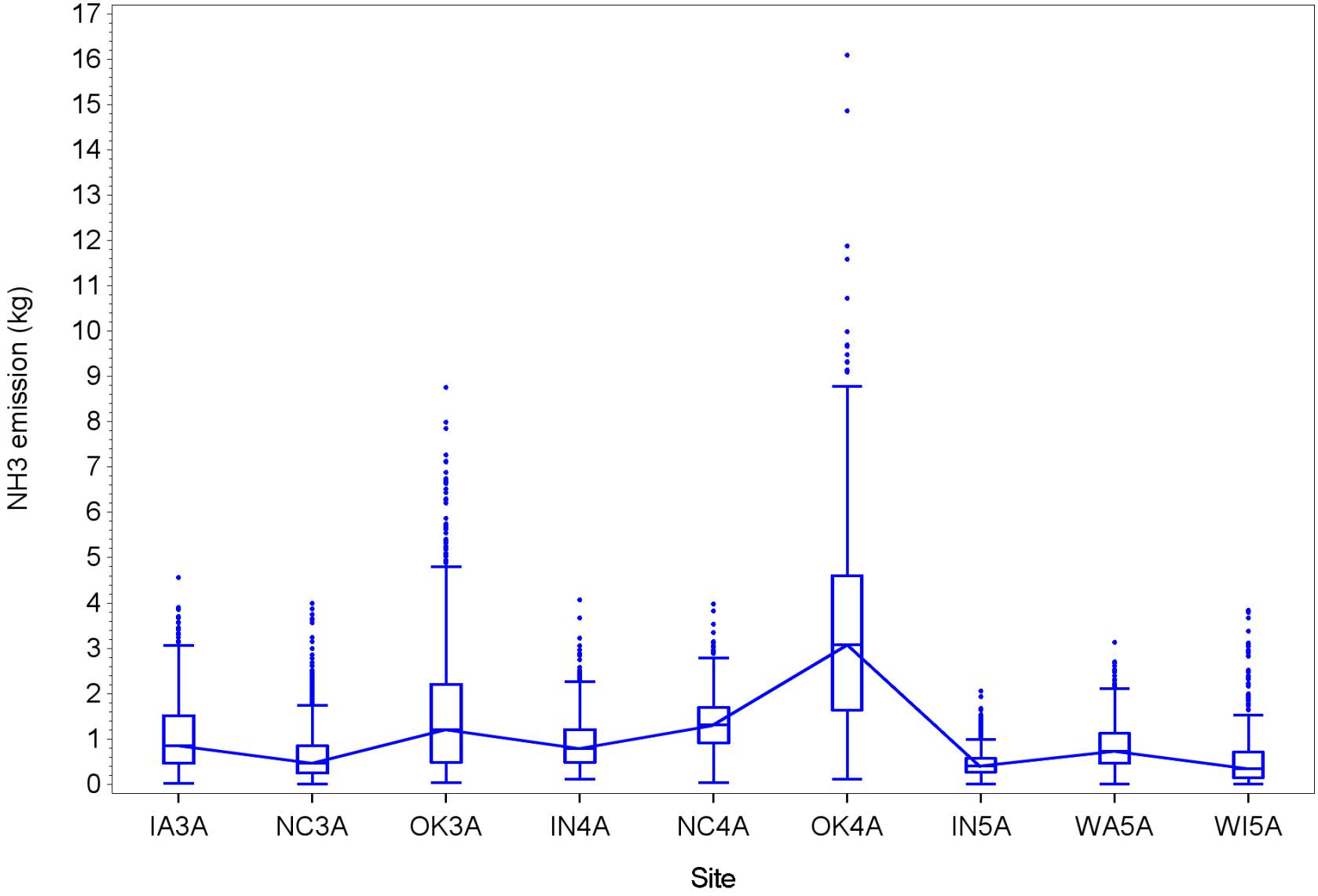
Analysis Variable : nh3 NH3 emission (kg)										
hour	N	Mean	Std Dev	Skewness	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Quartile Range
0	508	1.504	1.695	2.105	0	0.414	0.900	1.908	9.144	1.494
1	494	1.327	1.641	3.222	0	0.378	0.738	1.494	16.09	1.116
2	452	1.373	1.706	3.190	0.0180	0.396	0.774	1.629	14.87	1.233
3	451	1.285	1.515	2.452	0	0.414	0.738	1.386	8.568	0.972
4	443	1.317	1.444	1.831	0.0180	0.378	0.792	1.620	6.624	1.242
5	405	1.183	1.309	2.017	0.0540	0.342	0.684	1.296	6.300	0.954
6	380	1.164	1.282	1.797	0	0.342	0.648	1.404	6.300	1.062
7	365	1.044	1.148	1.989	0.0180	0.324	0.594	1.296	5.886	0.972
8	350	1.113	1.216	1.892	0.0360	0.360	0.594	1.278	5.796	0.918
9	330	1.077	1.186	1.984	0.0360	0.306	0.603	1.314	6.318	1.008
10	317	1.129	1.191	1.881	0.0360	0.342	0.648	1.404	6.948	1.062
11	342	1.106	1.134	1.693	0.0540	0.324	0.666	1.422	5.112	1.098
12	384	1.053	1.090	2.000	0.0540	0.324	0.657	1.296	6.120	0.972
13	469	1.065	1.088	2.241	0	0.378	0.684	1.332	7.434	0.954

Analysis Variable : nh3 NH3 emission (kg)										
hour	N	Mean	Std Dev	Skewness	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Quartile Range
14	484	1.242	1.312	2.065	0.0180	0.396	0.738	1.512	7.650	1.116
15	498	1.312	1.352	1.854	31E-19	0.396	0.810	1.638	7.722	1.242
16	510	1.335	1.284	1.814	0	0.432	0.936	1.710	8.352	1.278
17	502	1.377	1.311	1.653	0.0180	0.432	0.900	1.854	6.444	1.422
18	500	1.405	1.425	1.771	0.0360	0.432	0.855	1.827	7.344	1.395
19	503	1.419	1.375	1.651	0	0.414	0.918	1.944	7.236	1.530
20	535	1.430	1.397	1.990	0	0.468	0.900	1.890	8.460	1.422
21	545	1.481	1.663	2.484	0.0360	0.432	0.882	1.872	11.88	1.440
22	511	1.485	1.553	1.874	0	0.414	0.900	1.962	9.324	1.548
23	506	1.555	1.703	2.002	0.0360	0.414	0.855	2.052	9.486	1.638

1.1.4 By Site

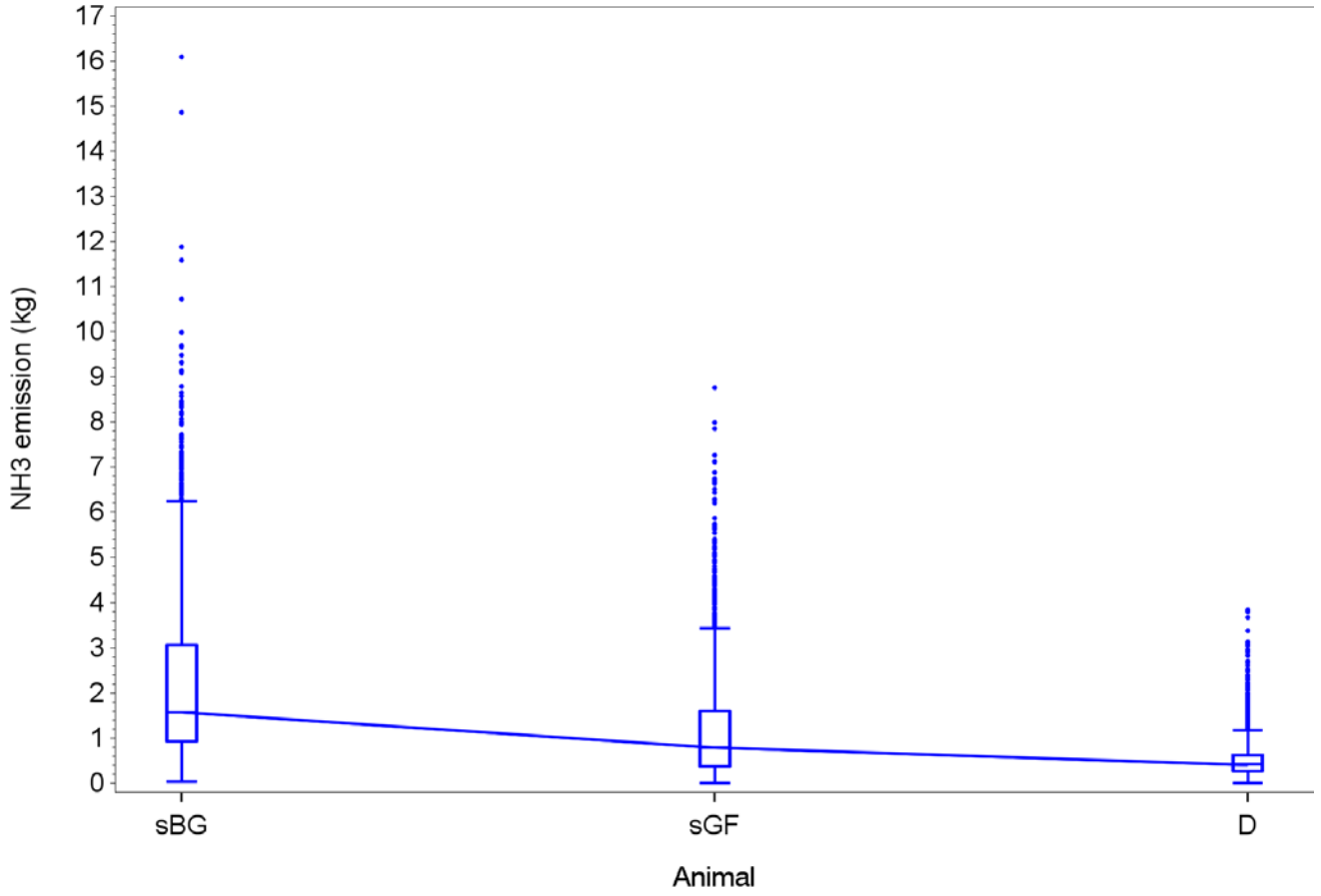
LABEL	ALL	IA3A	IN4A	IN5A	NC3A	NC4A	OK3A	OK4A	WA5A	WI5A
NH3 emission (kg)	10784	1048	677	2593	1074	1193	1600	1780	507	312

Analysis Variable : nh3 NH3 emission (kg)										
site	N	Mean	Std Dev	Skewness	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Quartile Range
IA3A	1048	1.067	0.776	1.119	0.0180	0.459	0.846	1.521	4.554	1.062
IN4A	677	0.934	0.572	1.367	0.108	0.486	0.792	1.206	4.068	0.720
IN5A	2593	0.437	0.239	1.399	0	0.270	0.396	0.558	2.052	0.288
NC3A	1074	0.632	0.585	2.163	0	0.234	0.468	0.846	3.996	0.612
NC4A	1193	1.336	0.623	0.421	0.0360	0.918	1.314	1.692	3.978	0.774
OK3A	1600	1.545	1.329	1.492	0.0360	0.486	1.206	2.214	8.766	1.728
OK4A	1780	3.260	1.969	0.776	0.108	1.638	3.078	4.608	16.09	2.970
WA5A	507	0.839	0.540	1.091	0	0.450	0.720	1.116	3.132	0.666
WI5A	312	0.624	0.766	2.116	0	0.144	0.342	0.702	3.834	0.558

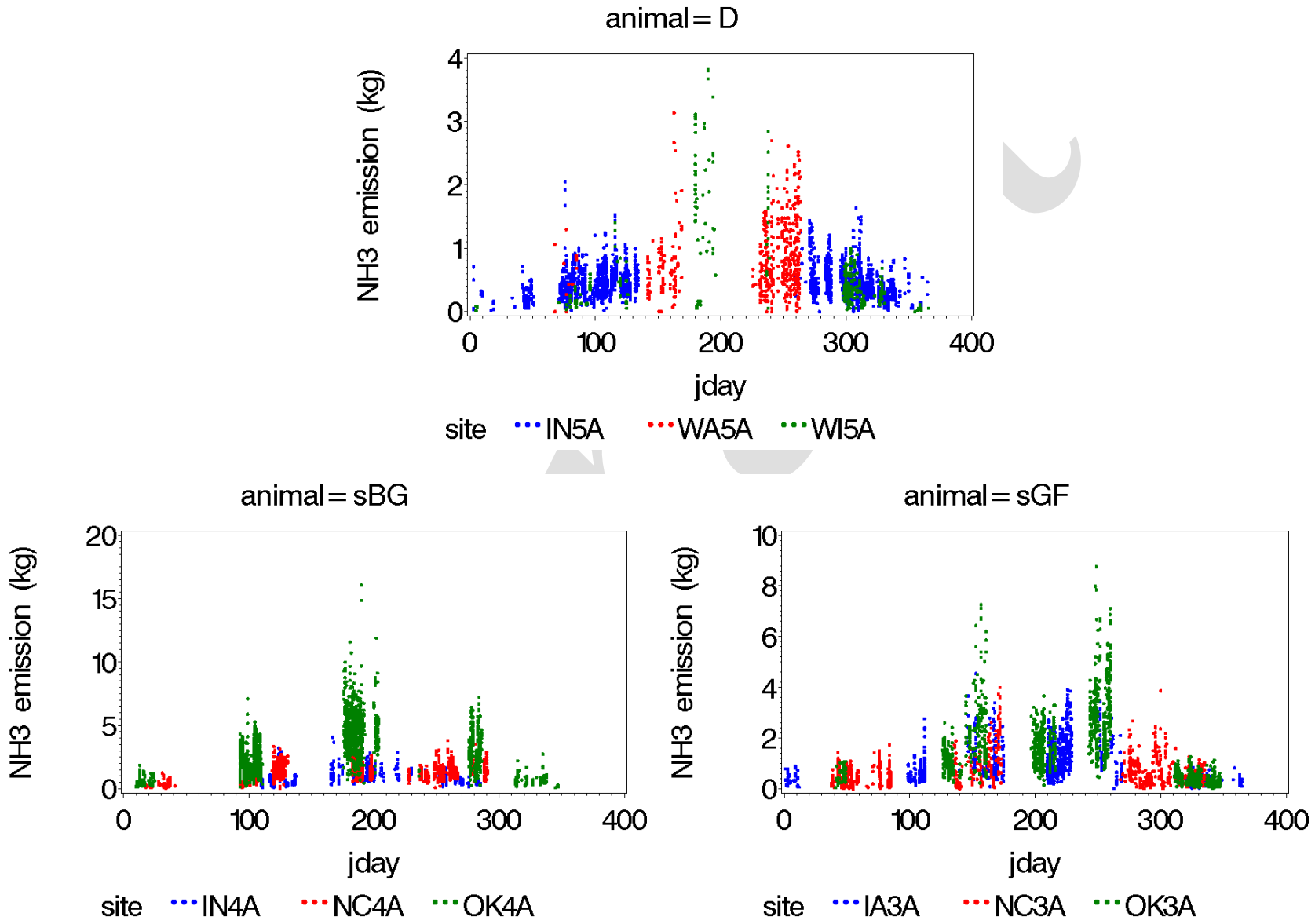

NH3 emission (kg)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
IA3A
NC3A
OK3A
IN4A
NC4A
OK4A
IN5A
WA5A
WI5A
Site

1.1.5 By Animal Type

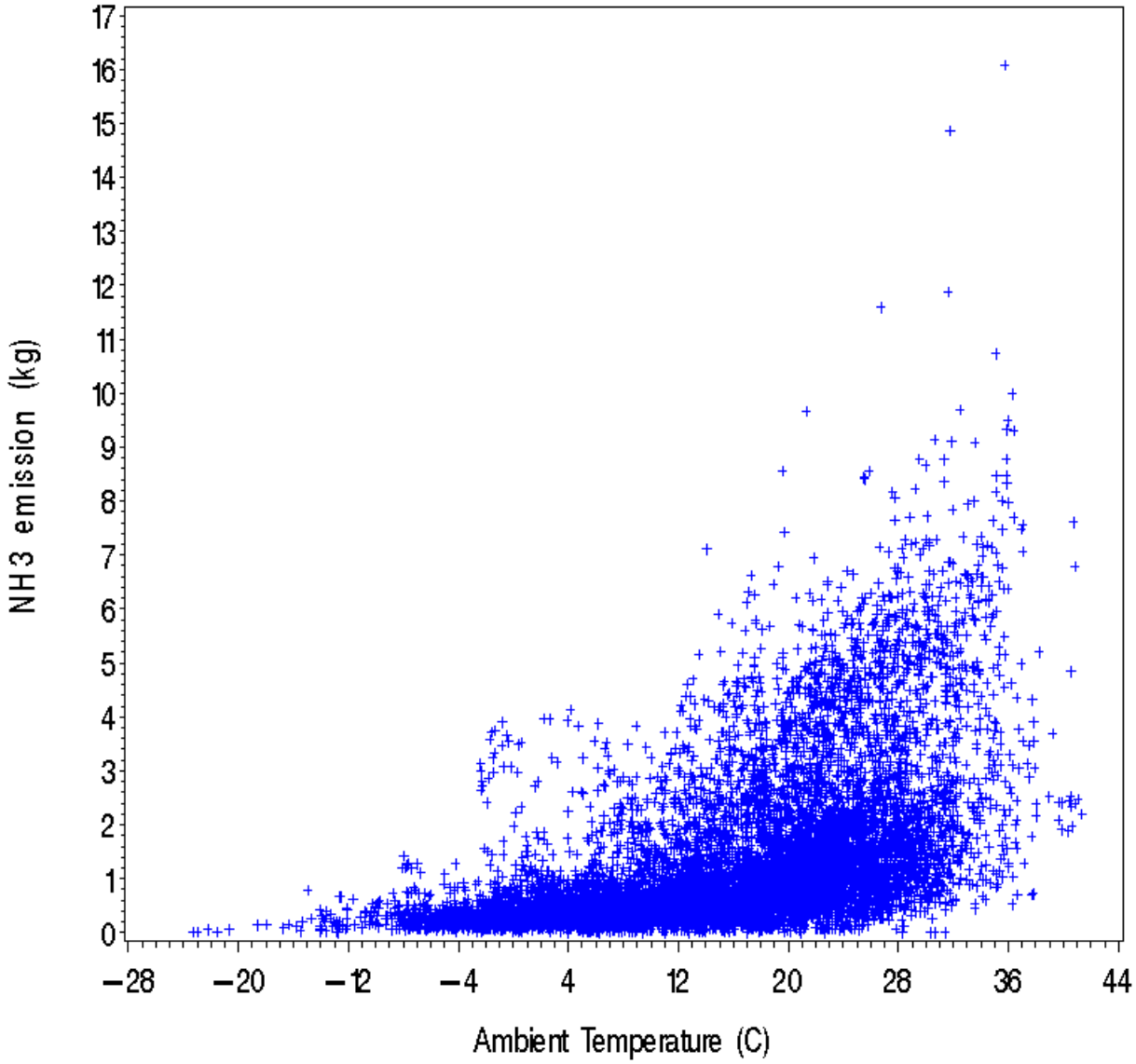
Analysis Variable : nh3 NH3 emission (kg)										
animal	**N**	**Mean**	**Std Dev**	**Skewness**	**Minimum**	**Lower Quartile**	**Median**	**Upper Quartile**	**Maximum**	**Quartile Range**
D	3412	0.514	0.402	2.787	0	0.270	0.414	0.630	3.834	0.360
sBG	3650	2.200	1.779	1.493	0.0360	0.936	1.566	3.060	16.09	2.124
sGF	3722	1.147	1.083	1.948	0	0.378	0.792	1.602	8.766	1.224



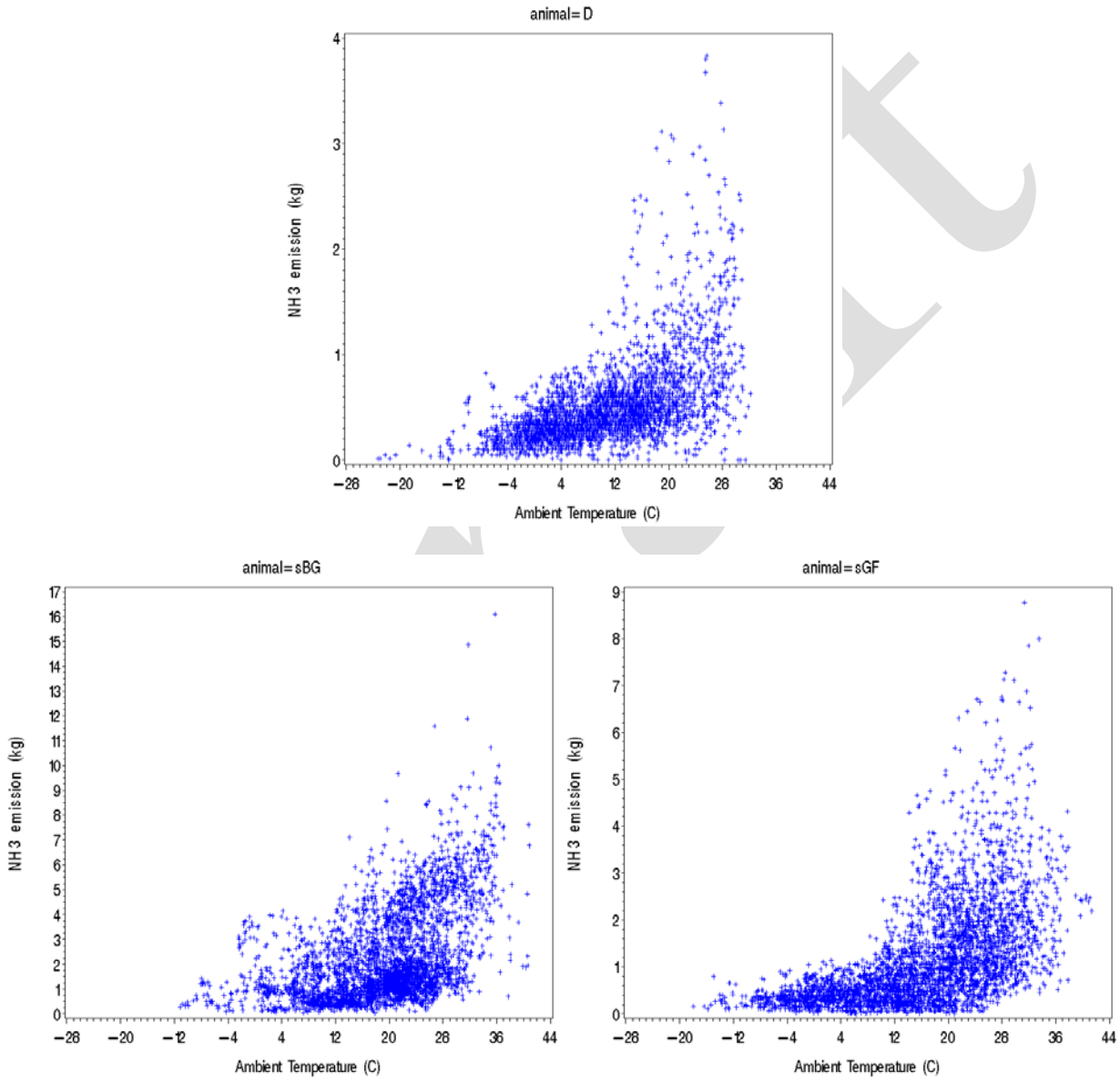
1.1.6 By Julian Day, by Animal Type, color coded by site



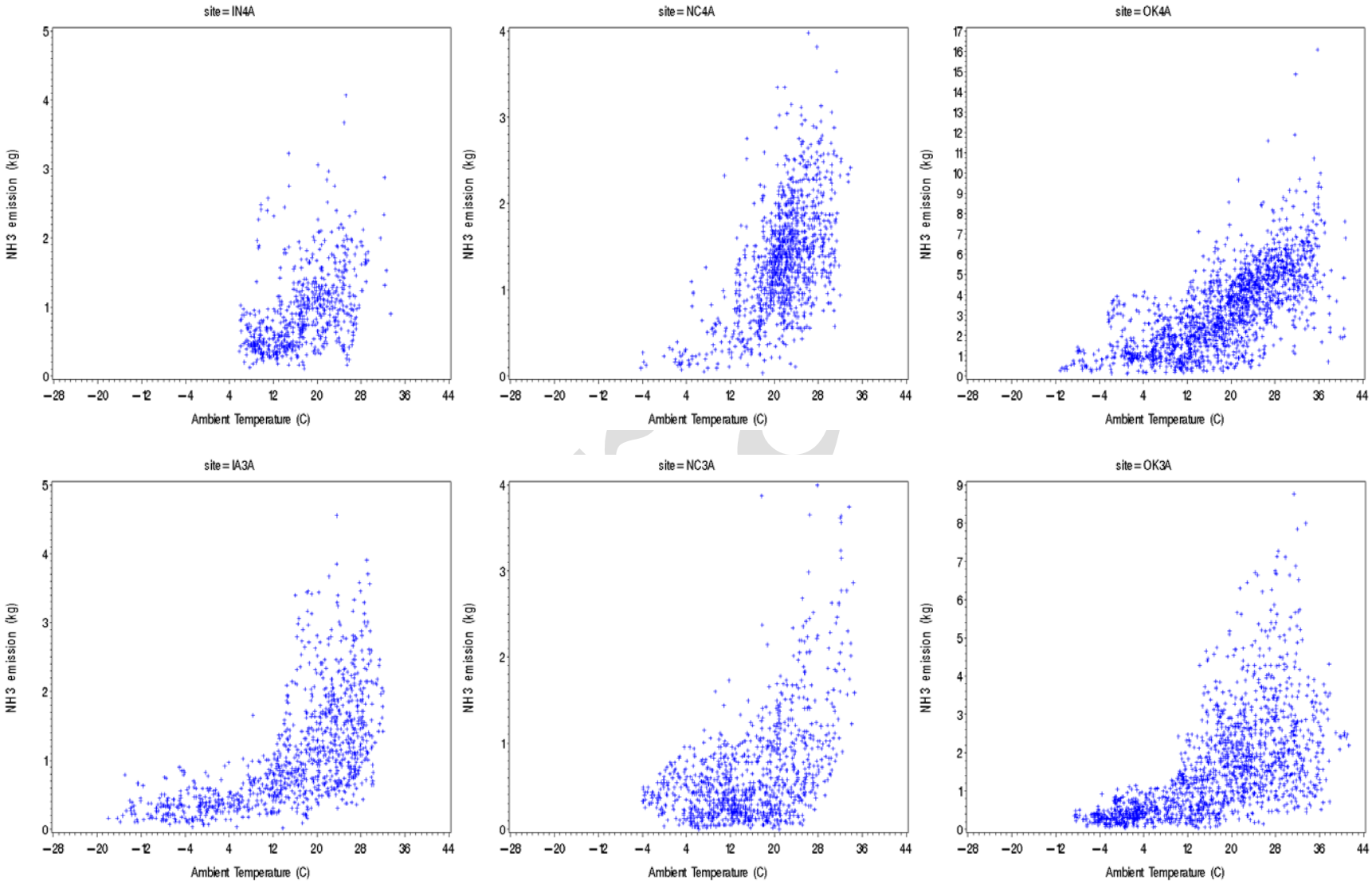
1.2 Ambient Temperature

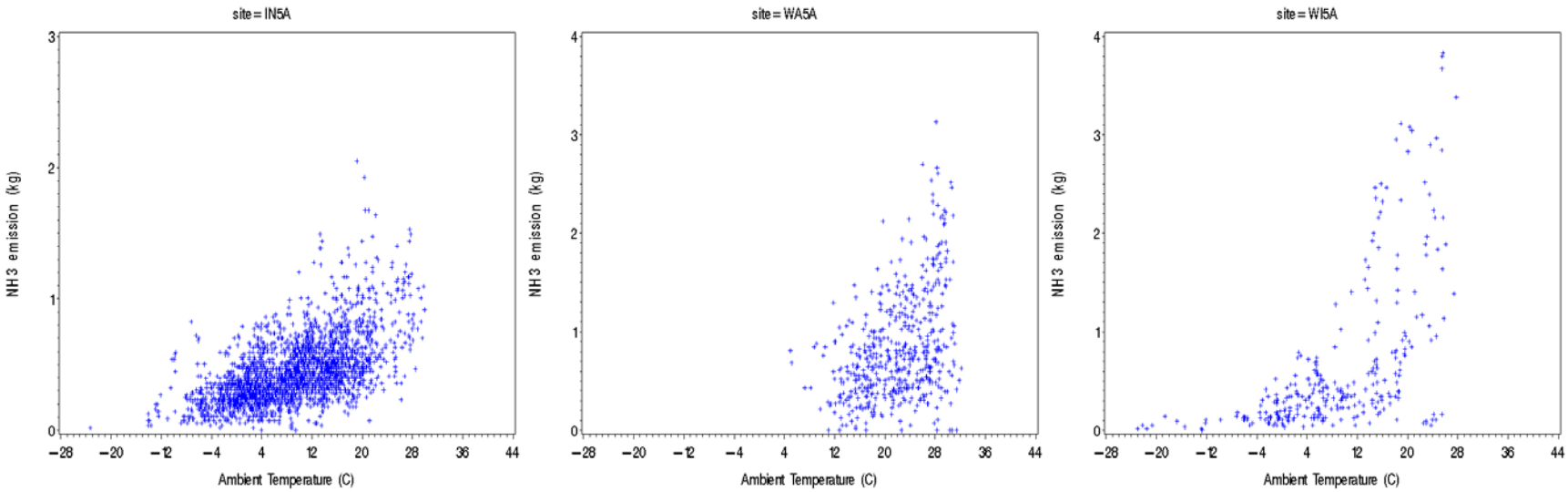


1.2.1 By Animal Type

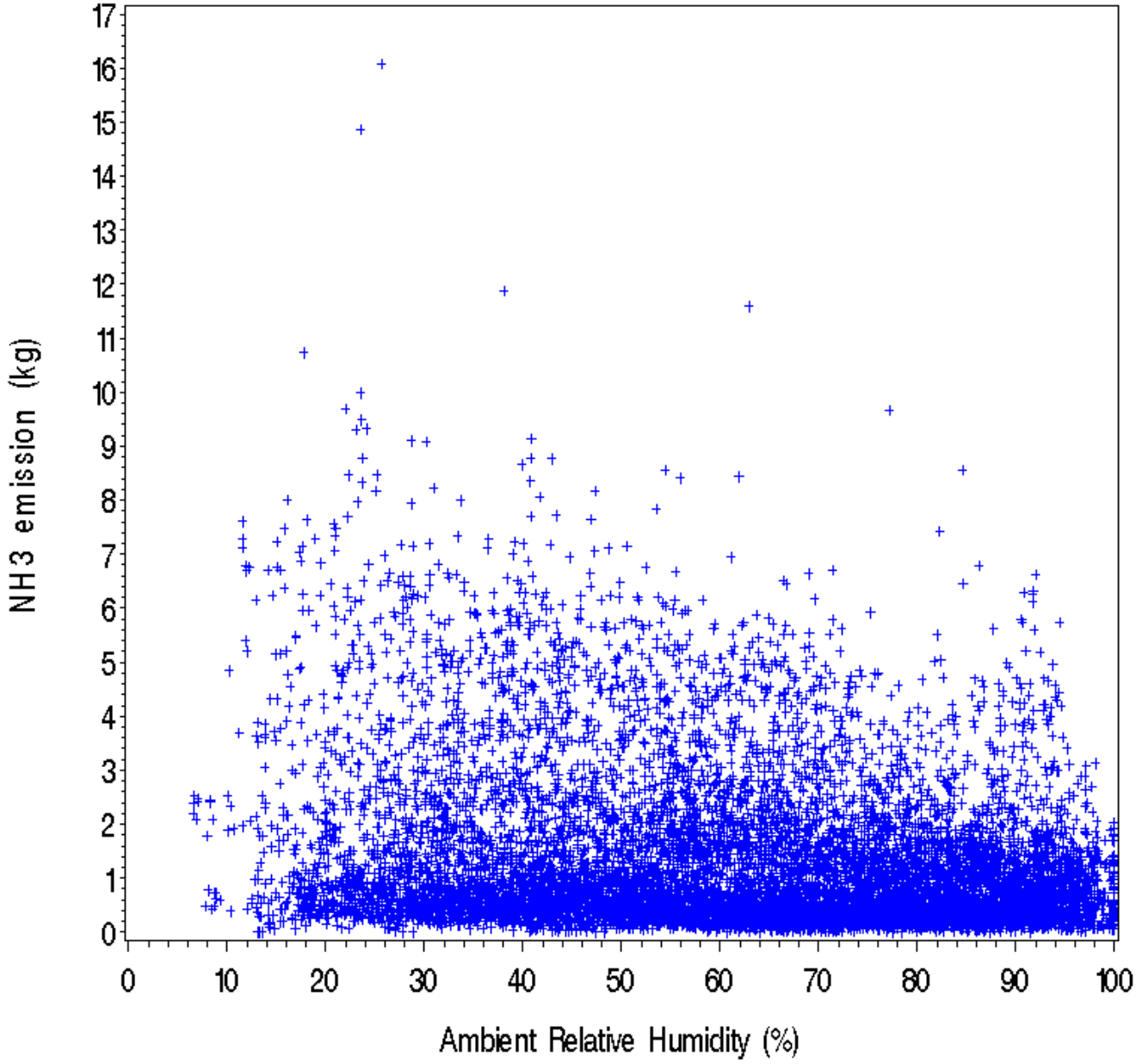


1.2.2 By Site

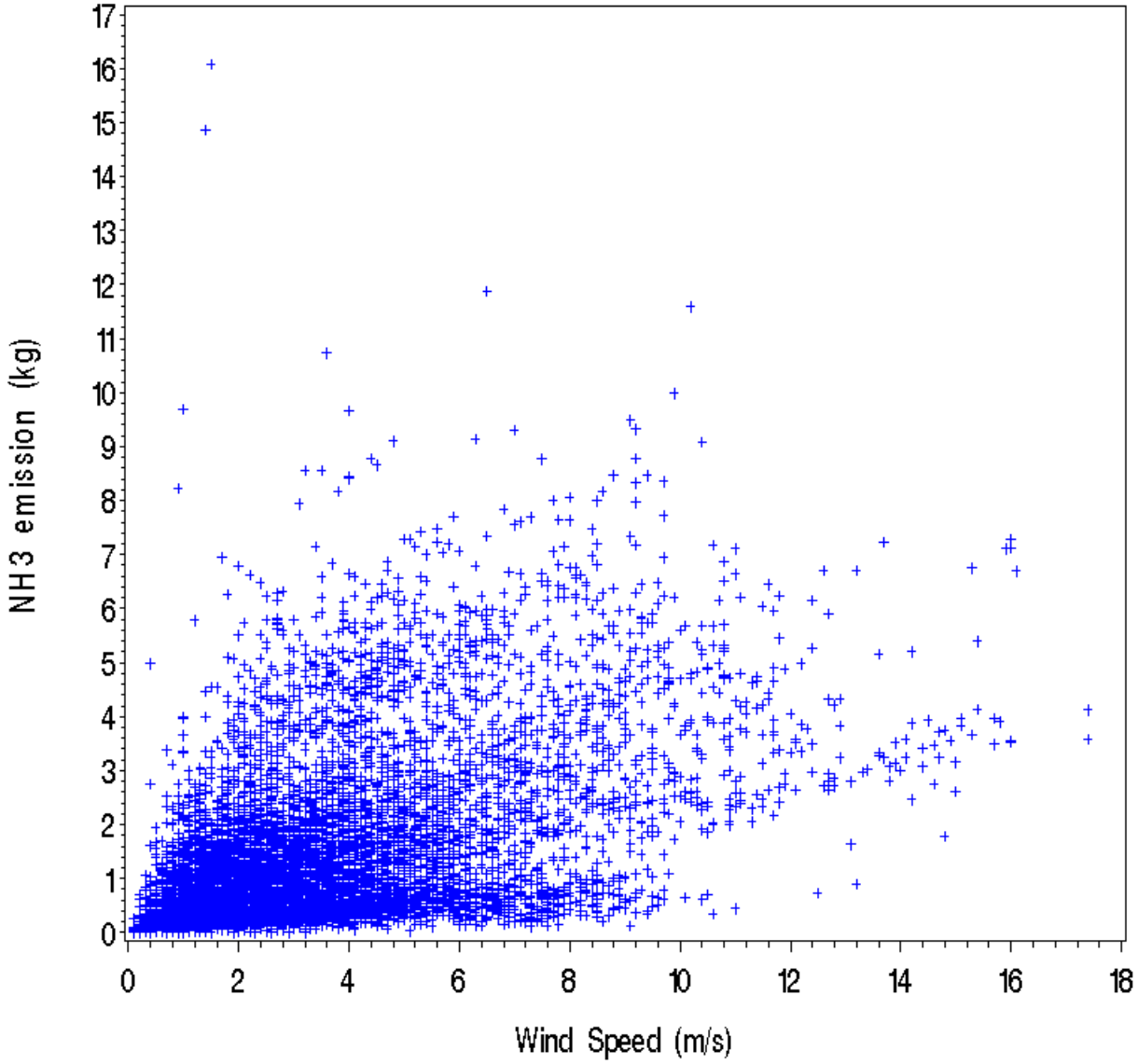

site = IN4A
site = NC4A
site = OK4A
site = IA3A
site = NC3A
site = OK3A
NH3 emission (kg)
Ambient Temperature (C)


site = IN5A
site = WA5A
site = WI5A
NH3 emission (kg)
Ambient Temperature (C)
0
1
2
3
4
−28
−20
−12
−4
4
12
20
28
36
44

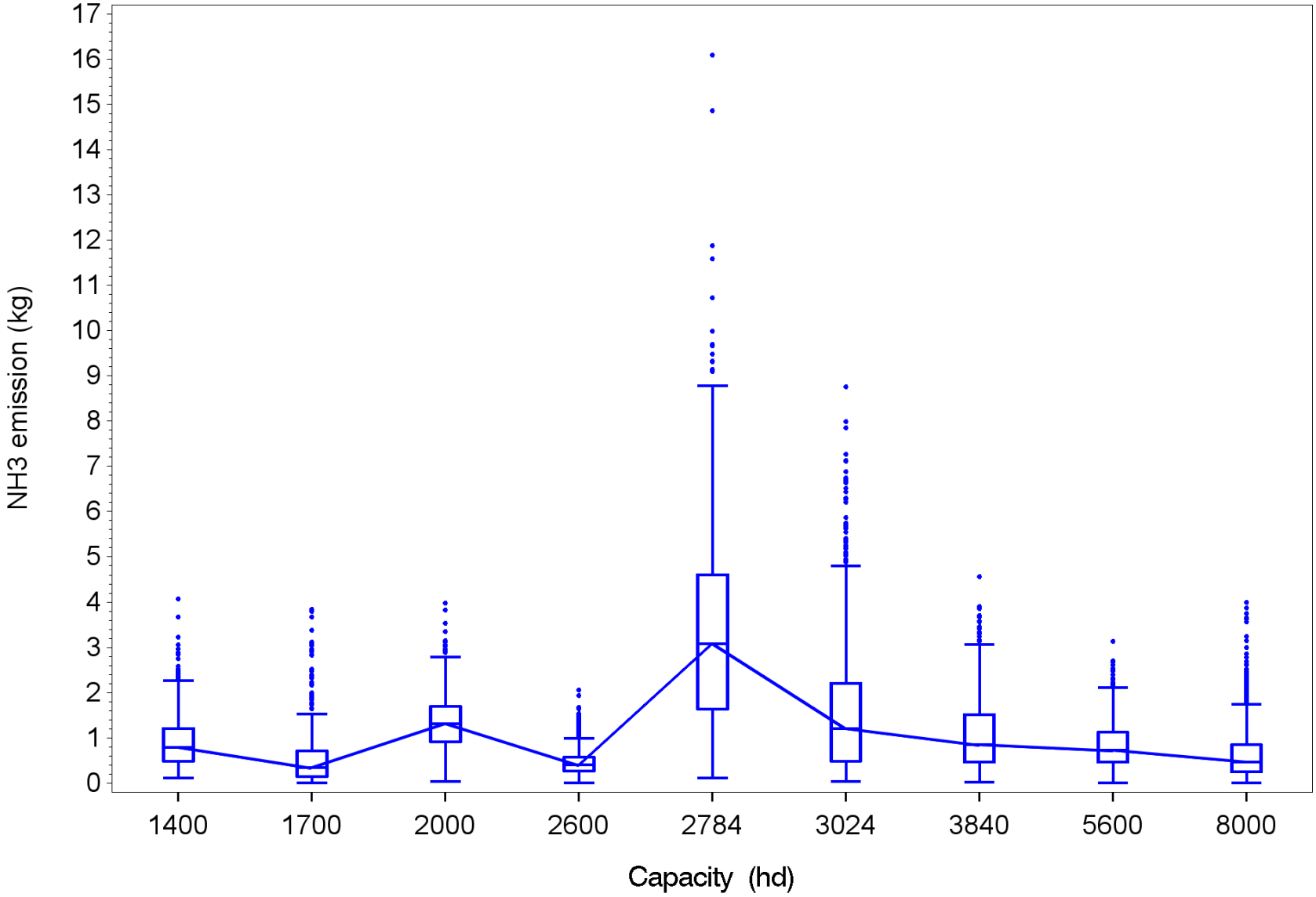
1.3 Relative Humidity

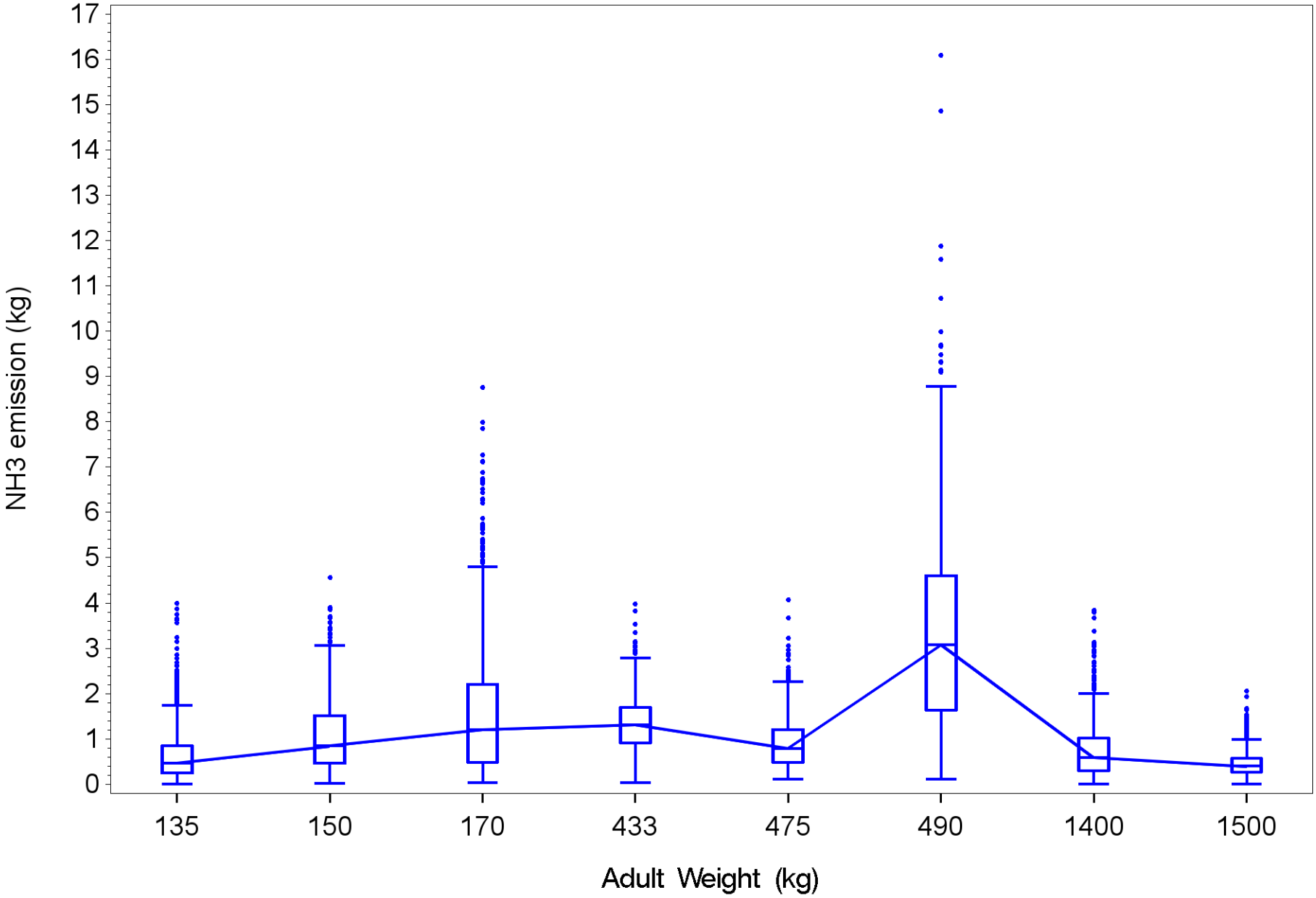


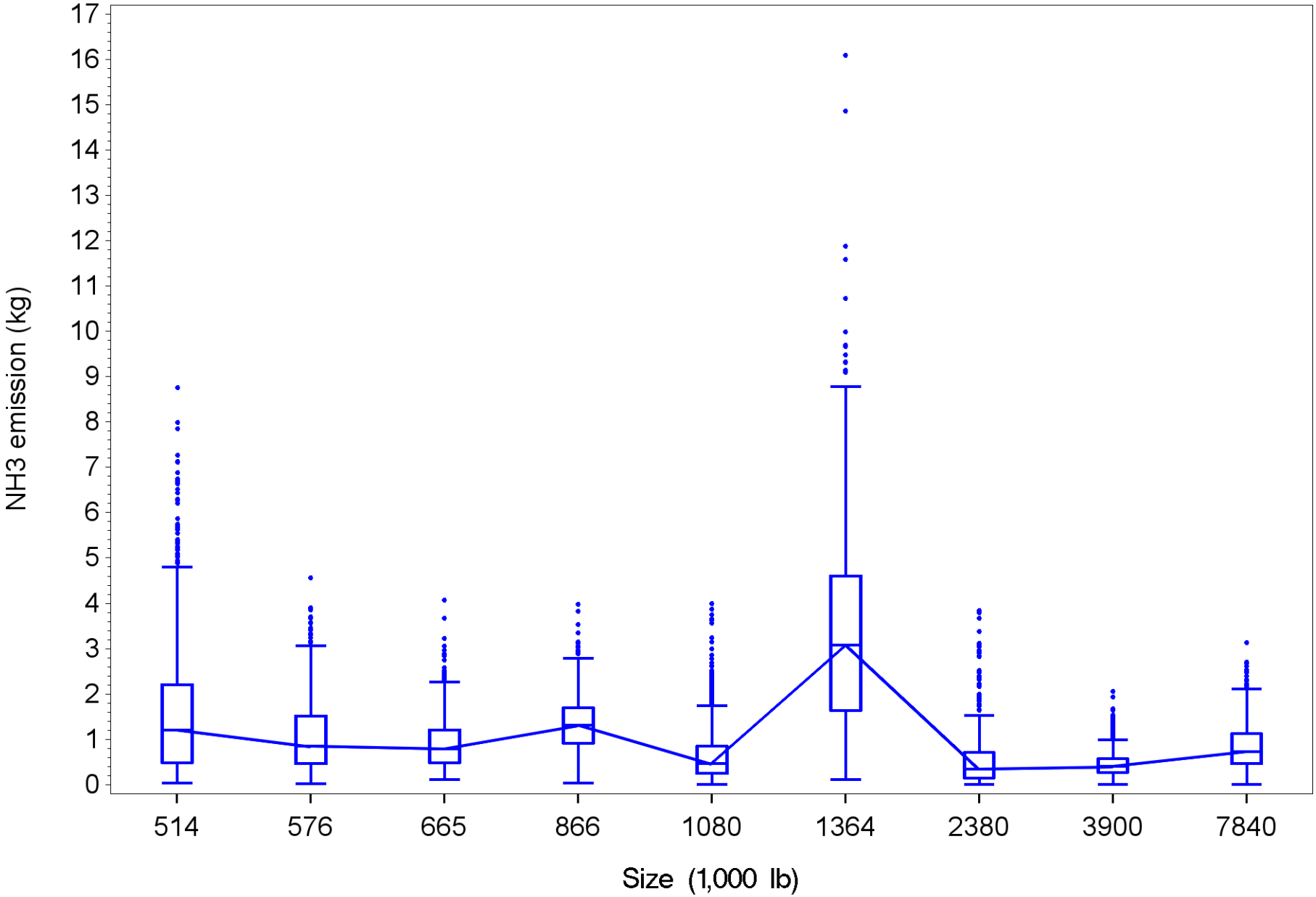
1.4 Wind Speed

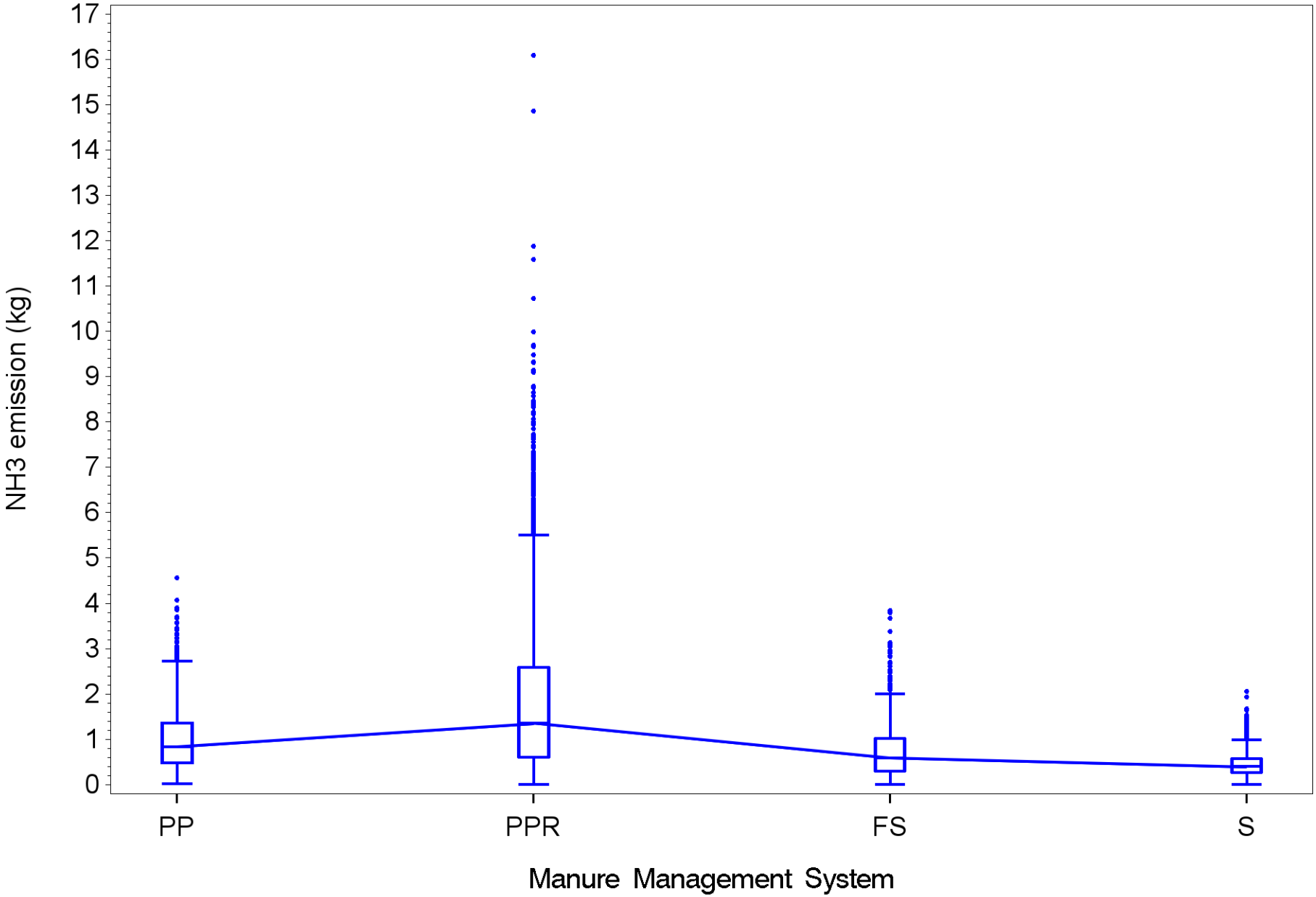


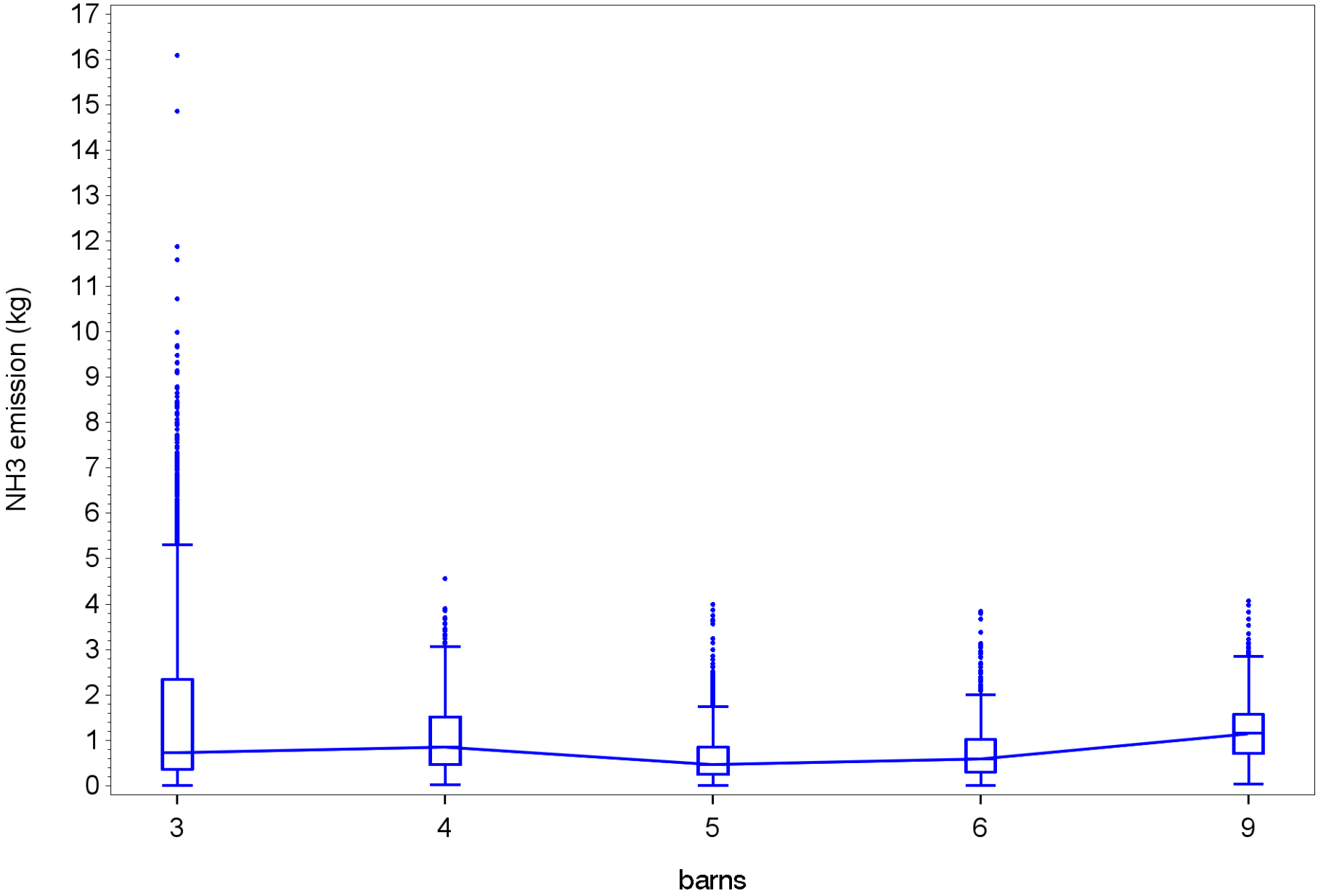
1.5 Categorical Variables

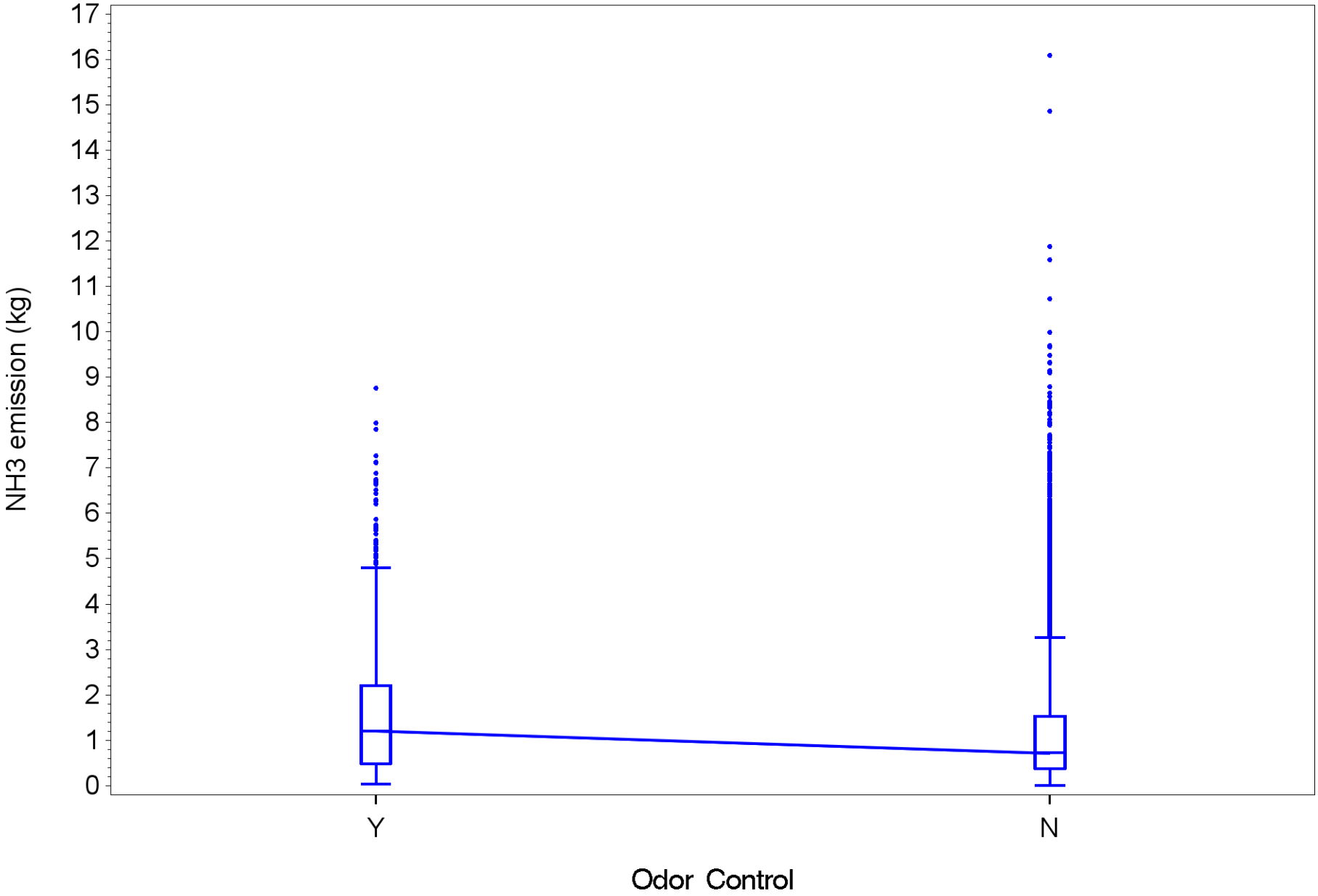


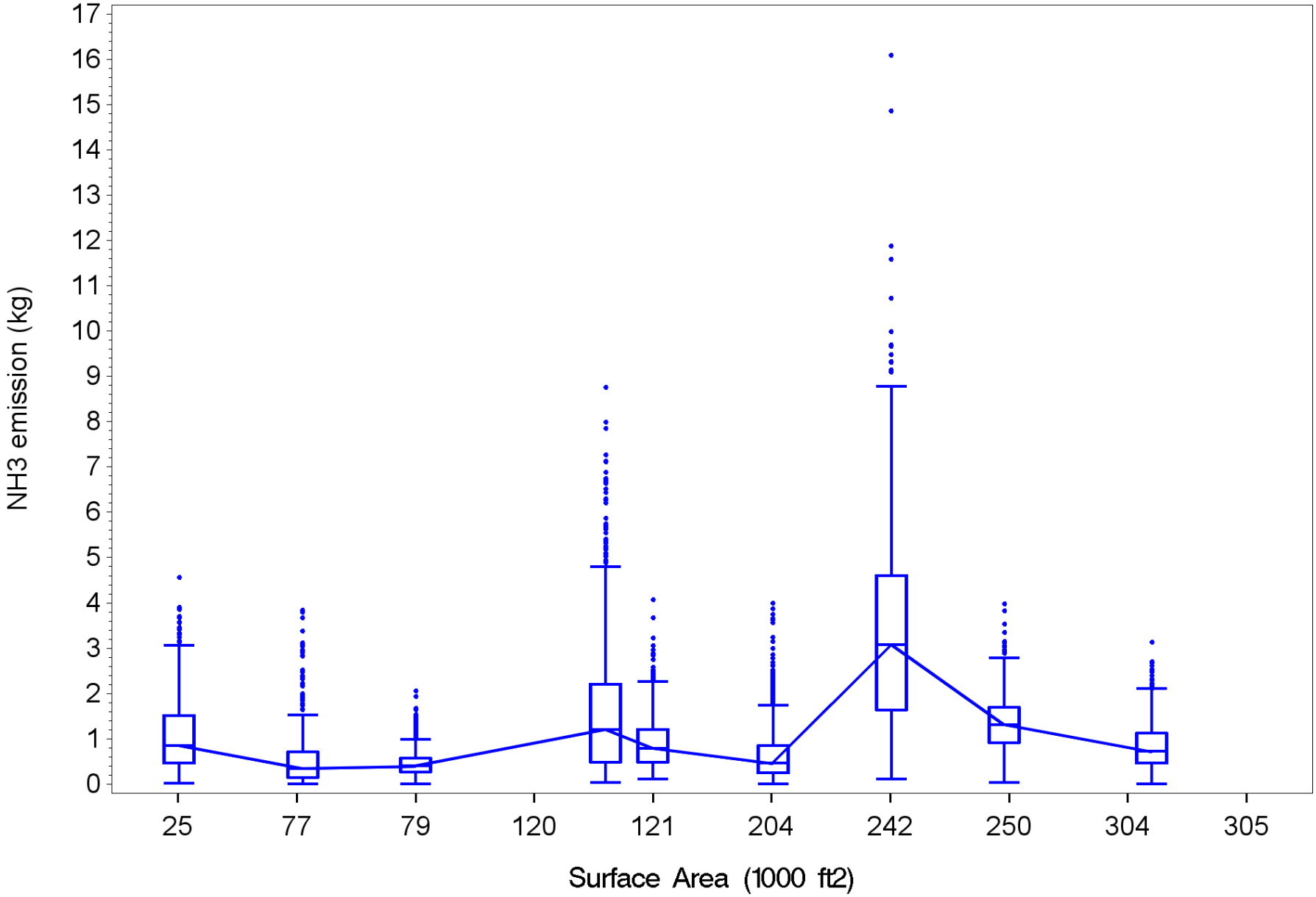

NH3 emission (kg)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
135
150
170
433
475
490
1400
1500
Adult Weight (kg)


NH3 emission (kg)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
514
576
665
866
1080
1364
2380
3900
7840
Size (1,000 lb)


NH3 emission (kg)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
PP
PPR
FS
S
Manure Management System


NH3 emission (kg)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
3
4
5
6
9
barns


NH3 emission (kg)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Y
N
Odor Control


NH3 emission (kg)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
25
77
79
120
121
204
242
250
304
305
Surface Area (1000 ft2)