



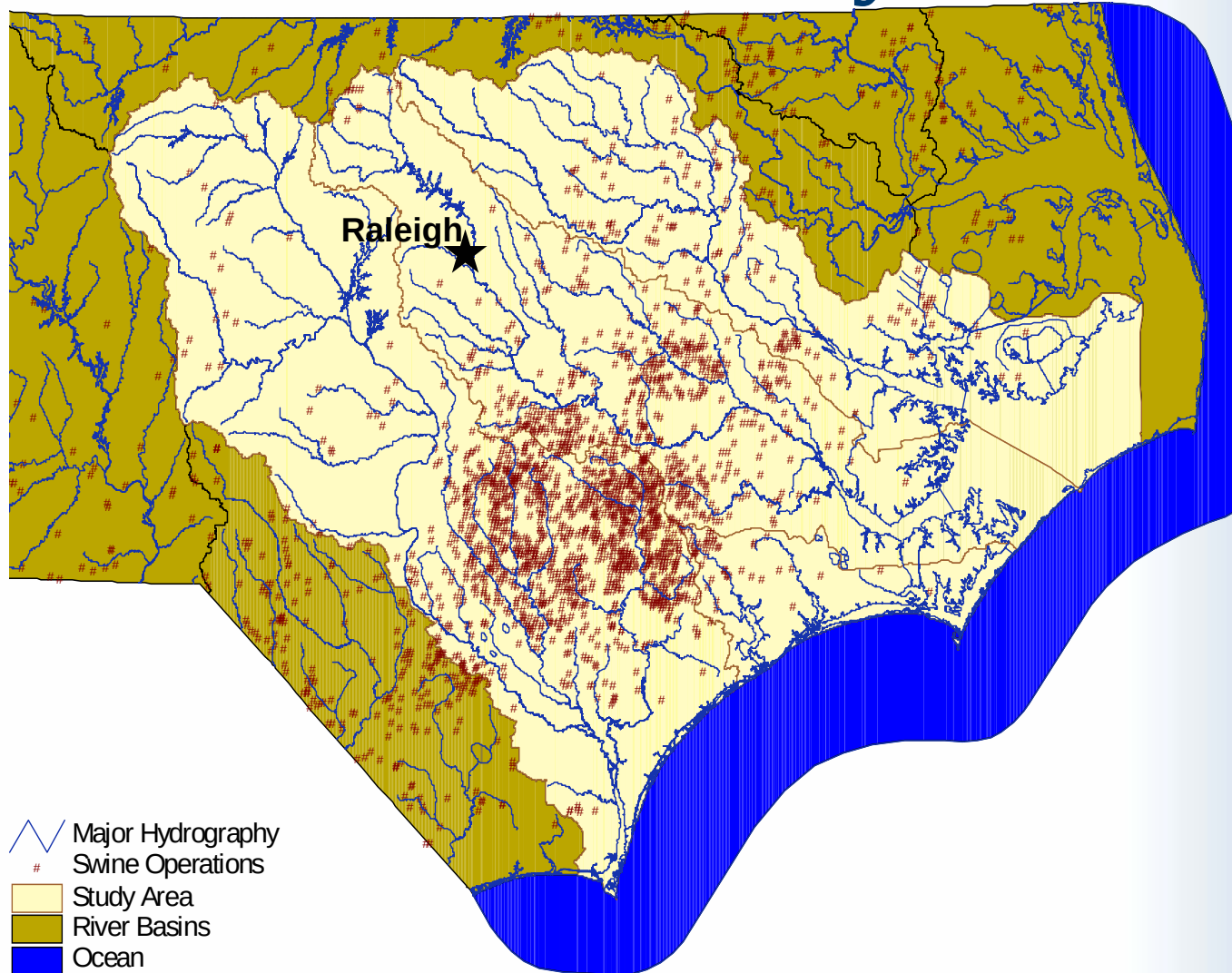
Growth-Stage Specific Ammonia Emission Factors for Swine CAFOs

Jeff Coburn and Marion Deerhake

Overview

- Introduction
- Model NC swine CAFOs
(concentrated animal feeding operations)
- Growth-stage specific emission factors
- Emission prediction comparisons
- Summary

Eastern NC Study Area



Available Information

- Location of 2,296 swine CAFOs in study area
- Growth-stages raised at each CAFO
- Number of head (sows) at each CAFO
- Steady-state live-weight at each CAFO

Question

- Is it important to estimate ammonia emissions by swine growth-stage?
- If so, what is the best method of estimating growth-stage-specific ammonia emissions?

Swine Growth-Stages



Model NC Growth-Stage CAFOs

Growth-stage	% of NC CAFOs	% by head	% by live-weight
Farrow-to-Wean	9.5	5.2	14.5
Wean-to-Fed	16.6	20.6	4.0
Farrow-to-Fed	6.9	2.7	7.7
Farrow-to-Finish	9.7	9.2	20.5
Feed-to-Finish	57.2	62.3	53.3

Emission Sources at Model NC Swine Operations



Emission Factor Development

- Performed literature review of swine emissions
 - ◆ Used 26 reports/articles
 - ◆ Included both European and U.S. studies
 - ◆ Gave preference to NC studies
- Categorized studies based on swine growth-stage
- Converted reported emissions to various forms of emission factors, whenever possible

Units for Emission Factors

- **Mass NH_3 per time per live-weight**
- **Mass NH_3 per time per head (or per pig)**
- **Mass NH_3 per time per animal unit**
 - ◆ 500 kg of live-weight
 - ◆ 10 swine under 55 lbs, 2½ swine over 55 lbs
- **Loss as a % of N excreted**
- **Loss as a % of N (or ammonium) entering unit**

Availability of Growth-stage-specific Emission Factors

Emission Source→ Growth-stage↓	House	Lagoon	Sprayfield
Farrow-to-Wean	√√	√	
Wean-to-Fed	√		
Farrow-to-Fed			
Farrow-to-Finish	√	√	√
Feed-to-Finish	√√	√	√

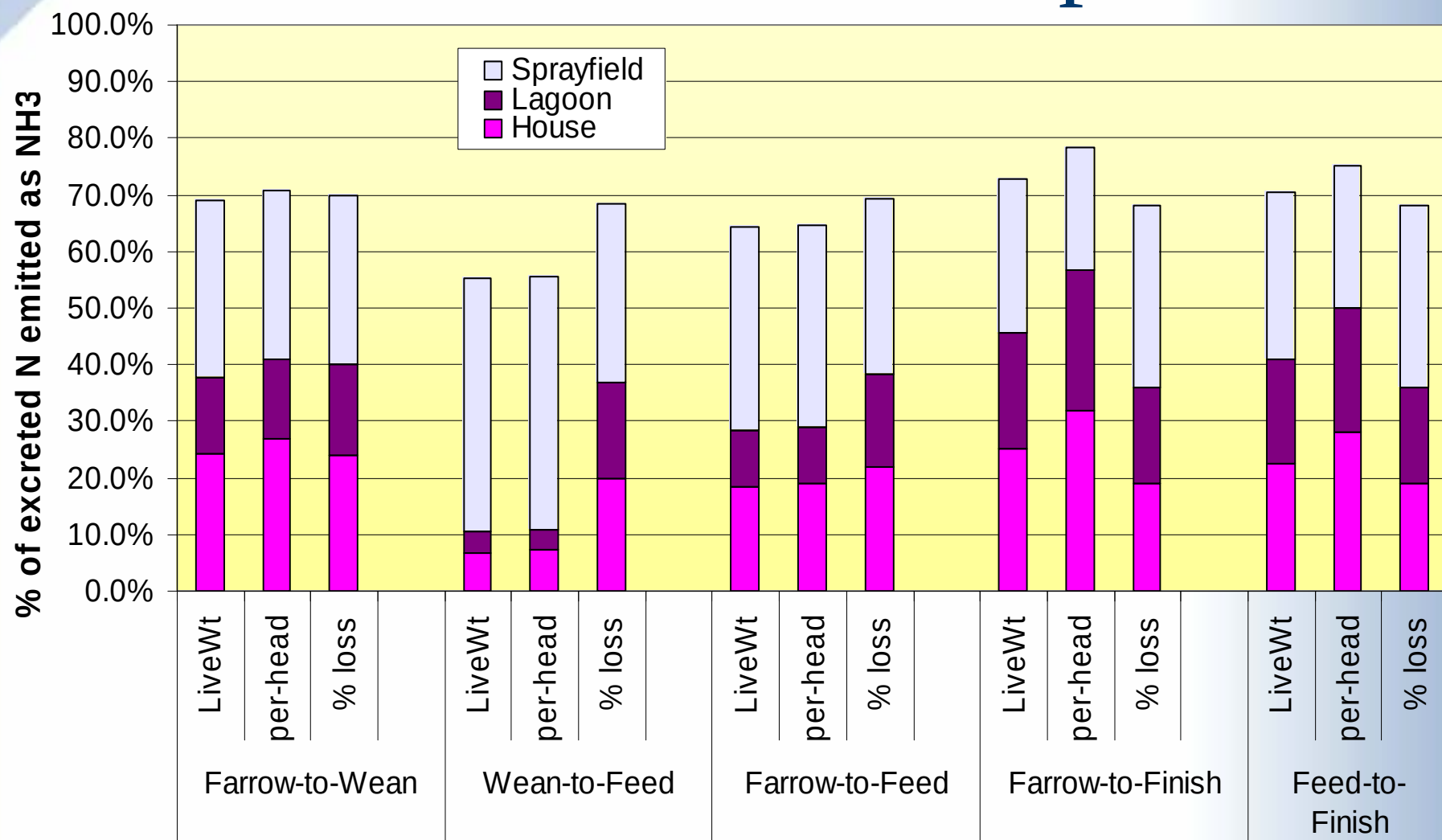
Nitrogen Mass Balance

- Assess number of animals in different growth stages for multiple growth-stage CAFOs
 - ◆ Assume 100 sows
 - ◆ Use NC values (2 litters/yr; 10 piglets/litter)
 - ◆ Calculate mix based on growth-stage periods
- Calculate total live-weight and cumulative amount of nitrogen excreted
- Track nitrogen availability in subsequent units

Internal Model Comparisons

- Compared growth-stage-specific ammonia emission estimates developed using
 - ◆ Per live-weight emission factors
 - ◆ Per head emission factors
 - ◆ Percent loss emission factors

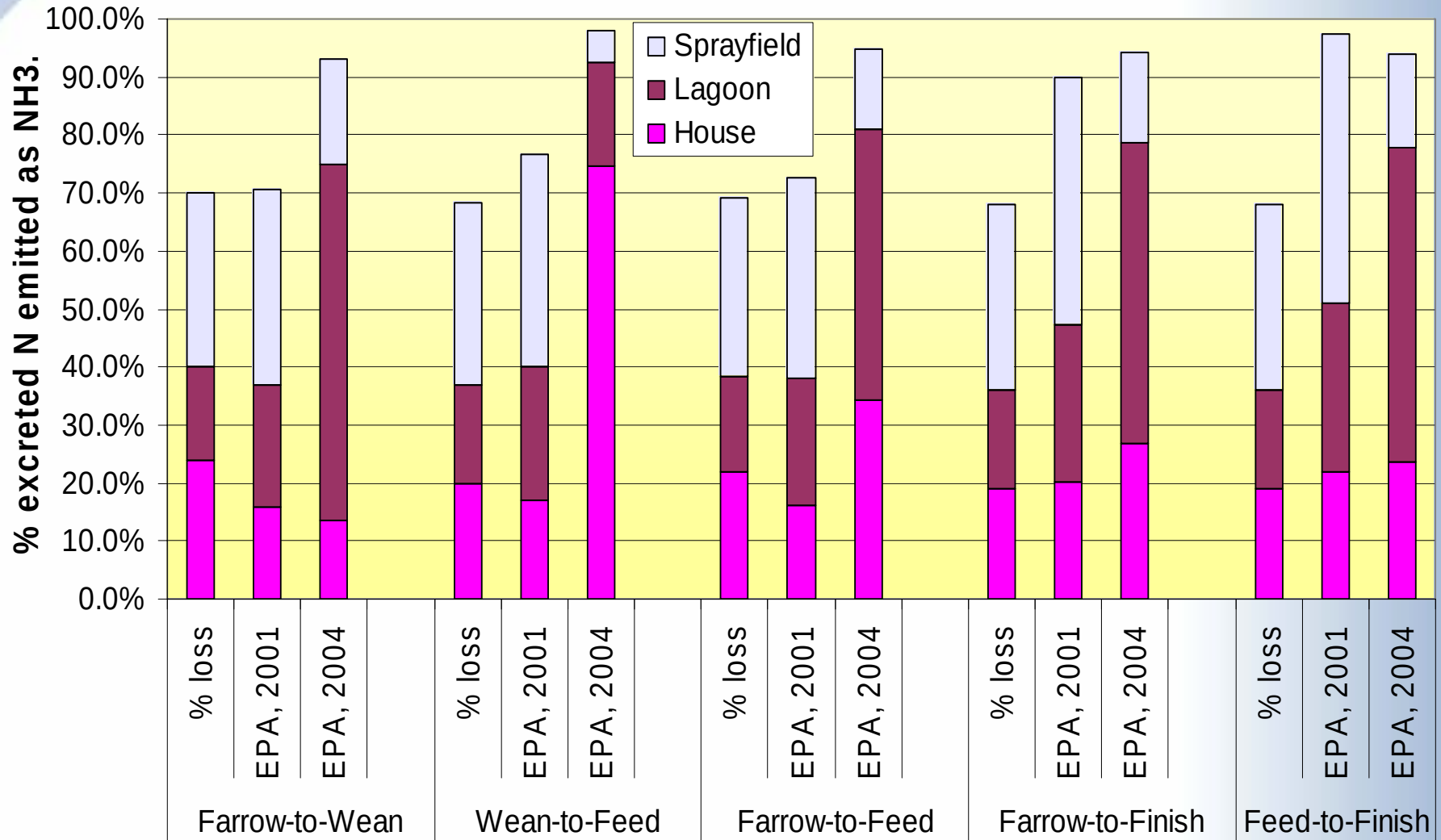
Internal Model Comparison



Additional Model Comparisons

- Compared the ammonia emission estimates developed using percent loss emission factors with other emission inventory methods
 - ◆ Fixed per animal unit emission factors (EPA, 2001)
 - ◆ Draft NEI approach (EPA, 2004)
 - 2.7 kg/yr/head for housing
 - 71% for lagoon
 - 27.5% for sprayfields

Additional Model Comparison



Summary

- Per head and per live-weight emission factors are dependent on growth-stage
- Significant data gaps exist for certain growth stages
- A unit or process based approach, that accounts for serial losses, is recommended



Turning Knowledge into Practice

Research Triangle Park, North Carolina