

Data Update: Animal populations

8/14/2026

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Why do animals matter?

Real world:

- Agricultural products

Model world:

- Proxy for nutrients

Historical Data

Census of Agriculture

- Every 5 years from 1982 to 2022.
- In between years are interpolated.

USDA-NASS's Poultry Production and Value surveys

- Statewide population for broilers and turkeys are provided annually.



= hierarchical data filling

Where do we get animal numbers from?

Animal Type	Population data source	Type of data
Beef	Five-year Census of Ag	NASS Census inventory
Diary	Five-year Census of Ag	NASS Census inventory
Other Cattle	Five-year Census of Ag	NASS Census inventory
Horses	State-sponsored horse census data	State equine survey inventory
Hogs for Breeding	Five-year Census of Ag	NASS Census inventory ('17, '22, calculated as ratio based on '12)
Hogs for Slaughter	Five-year Census of Ag	NASS Census Co. inventory and State sales (equation), ('17, '22 corrected for sows)
Sheep and Lambs	Five-year Census of Ag	NASS Census inventory
Goats	Five-year Census of Ag	NASS Census inventory
Pullets	Five-year Census of Ag	NASS Census Co. inventory and State sales (equation)
Layers	Five-year Census of Ag	NASS Census inventory
Broilers	Five-year Census of Ag Annual Survey of Ag USDA-NASS's Poultry Production and Value surveys	COA Co. inventory, Survey annual state production (equation) If St. data missing, use Poultry Production and Value surveys If still missing use smaller of last report or 500,000
Turkeys	Five-year Census of Ag Annual Survey of Ag USDA-NASS's Poultry Production and Value surveys	COA Co. inventory, Survey annual state production (equation) If St. data missing, use Poultry Production and Value surveys If still missing use smaller of last report or 500,000

Replacing Non-Disclosed Values

Non-Disclosed value:

When fewer than five operators of a specific animal type exist within a county

Method 0 (Subtraction): Calculates the single missing county by subtracting all reported county totals from the known state total.

Method 1 (Time Interpolation): Estimates missing data by drawing a straight-line trend between the closest past and future reported years for that county.

Method 2 (Historical Share): Divides the remaining state data among hidden counties based on their historical percentage of the state's animal population.

Method 3 (State Regression): Rebuilds missing state-level totals by running a broad statistical regression across all historical census years.

Method 4 (Land Footprint): Distributes leftover livestock numbers based on a county's physical acreage of available pasture and cropland.

What if we don't have a direct data source?

Pullets and other animals with no annual production data (hogs for slaughter)

- $\text{Birds Produced/Year} = (\text{Year-End Inventoried Birds} \times 1/\text{Cycles of Birds per Year}) + [(\text{Annual Birds Sold}/\text{Cycles of Birds per Year}) \times ((\text{Cycles of Birds per Year}-1)/\text{Cycles of Birds per Year})]$
- Assumed 2.25 flocks per year

Broilers and Turkeys

- $\text{Countywide Birds Produced/Year} = \text{Statewide Birds Produced/Year} \times (\text{Countywide Ag Census Inventoried Birds}/\text{Ag Census Statewide Birds Produced})$

Example equations, data sources are not always what is listed in this slide.

How do we forecast populations?

** (NOTE this will be a topic of discussion later)

- Double exponential smoothing
 - Short-term data forecasting method
 - Often used when future values are believed to be related to both long-term and short-term trends in historic values.
 - Combine predictions of long and short-term trends by placing different weights or emphasis on each type of trend.
- Recommended by AMS for Phase 6 Watershed Model (CAST) and approved through AgWG, Water Quality GIT, etc.

How do we get from populations to nutrients?

- **Goal: Calculate Lbs of Nitrogen from manure**
- Equation:
 - $(\text{Lbs N/ Month}) = (\text{Animal Units}) \times (\text{Dry waste generated/year}) \times (\text{Lbs N/Lb Dry Manure}) / (12 \text{ months/year}) \times (\text{fraction of time in confinement})$
- Example:
 - $788 \text{ Lbs N/Month} = (1000 \text{ Animal Units of Beef}) \times (5,475 \text{ Lbs Dry Manure/Lbs/Year}) \times (0.028788 \text{ Lbs N/Lb Dry Manure}) / (12 \text{ Months/year}) \times (0.06 \text{ fraction of time in confinement})$

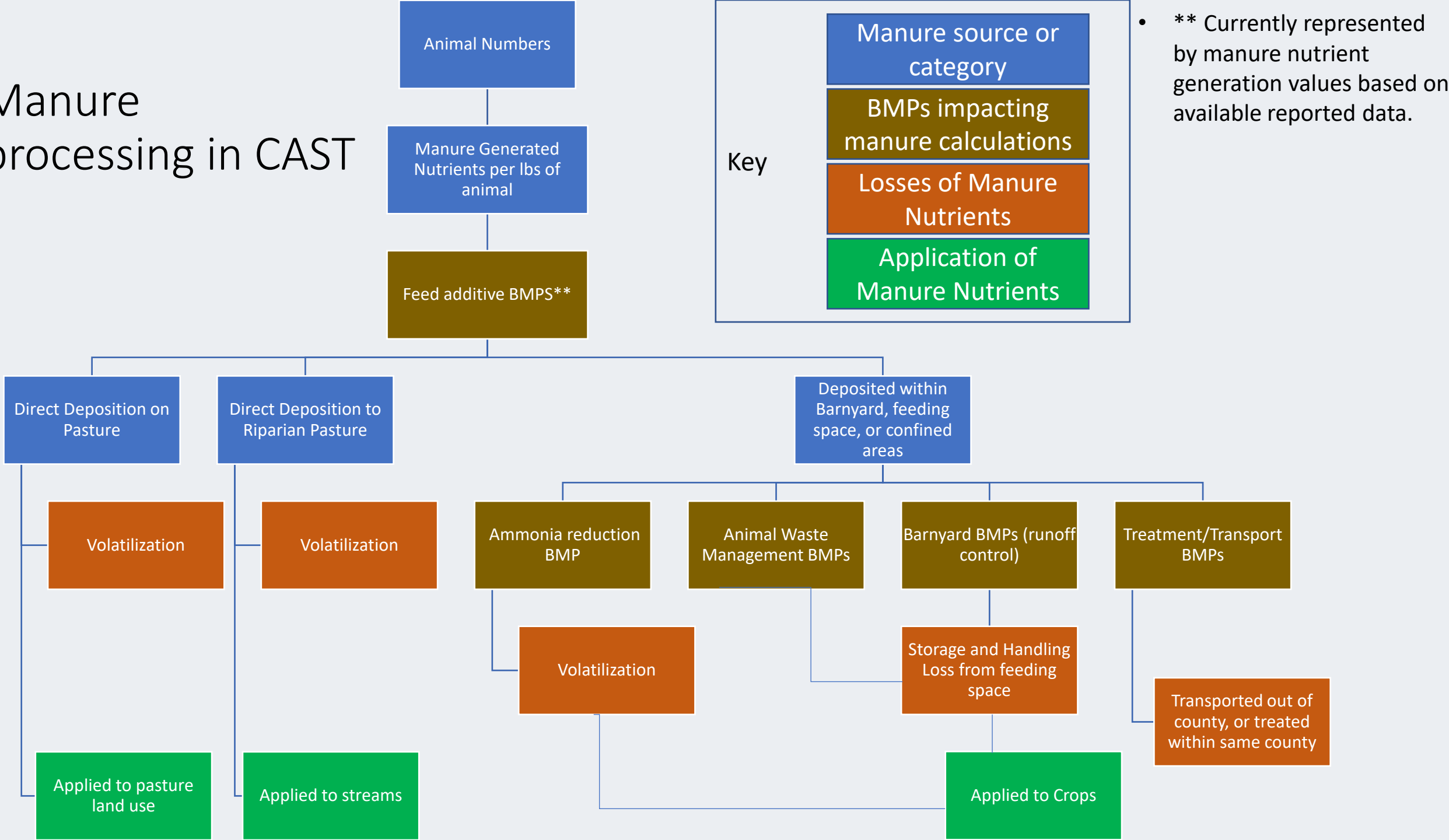
Assumptions:

- Average day of a given year
- Estimated population
- 1000 Lbs = 1 Animal Unit
- Fraction of time in confinement is state supplied percentage
 - 0.06 Fraction = 6% of time in confinement

Table 3-4: Total nutrient manure characteristics for livestock

Animal Type	Manure Source	Lbs Dry Manure/Animal/Year	Lbs TN/Lb Dry Manure	LbsTP/Lb Dry Manure
Beef	Beef - Cow (confinement) from ASAE 2005 for manure values	5,475.00	0.028788	0.006467
Dairy	Lactating Cow, Dry Cow and Heifer from ASAE 2005 for manure values	4,404.33	0.042221	0.006764
Other Cattle	Estimated based upon weighted average combination of Beef and Dairy from Census of Agriculture; See Appendix D	1,605.07	0.035504	0.006616
Horses	Average of Horse- Sedentary and Horse - Intense Exercise from ASAE 2005 for manure values	3,102.50	0.031672	0.005941
Hogs for Breeding	Swine Characterization Report; See Appendix E	220.62	.294653	Varies
Hogs for Slaughter	Swine Characterization Report; See Appendix E	97.09	0.106841	Varies
Sheep and Lambs	ASAE 2003 for manure values	240.9	0.038182	0.007909
Goats	ASAE 2003 for manure values	680.91	0.034615	0.008462
Pullets	PLS Report; See Appendix A	12.95	Varies	Varies
Layers	PLS Report; See Appendix A	17.89	Varies	Varies
Broilers	PLS Report; See Appendix A	Varies	Varies	Varies
Turkeys	Turkey Characterization Report; See Appendix F	7.62	Varies	Varies

Manure processing in CAST



Things to remember about manure:

- Manure nutrients stay in their county of origin UNLESS they are transported
- After application to fields volatilization occurs reducing plant available nutrients
- Additional BMPs can be used to increase the plant available nutrients

What do CAST animal populations look like?

2017 was last Census of Ag used in Phase 6

2022 is the most recent Census of Ag for Phase 7

New data denoted by vertical dotted line

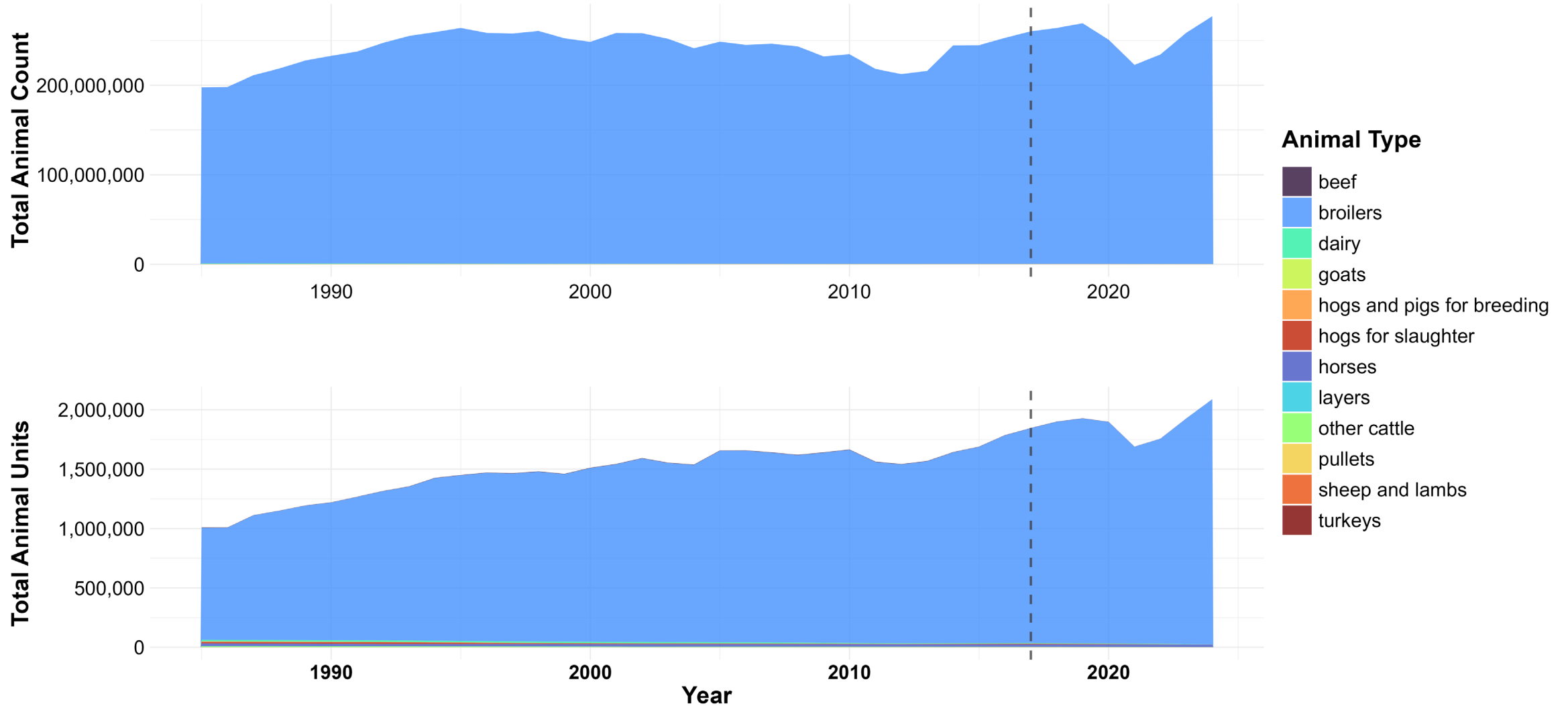
Animal population

Animal Unit

- 1000 Lbs = 1 Animal Unit

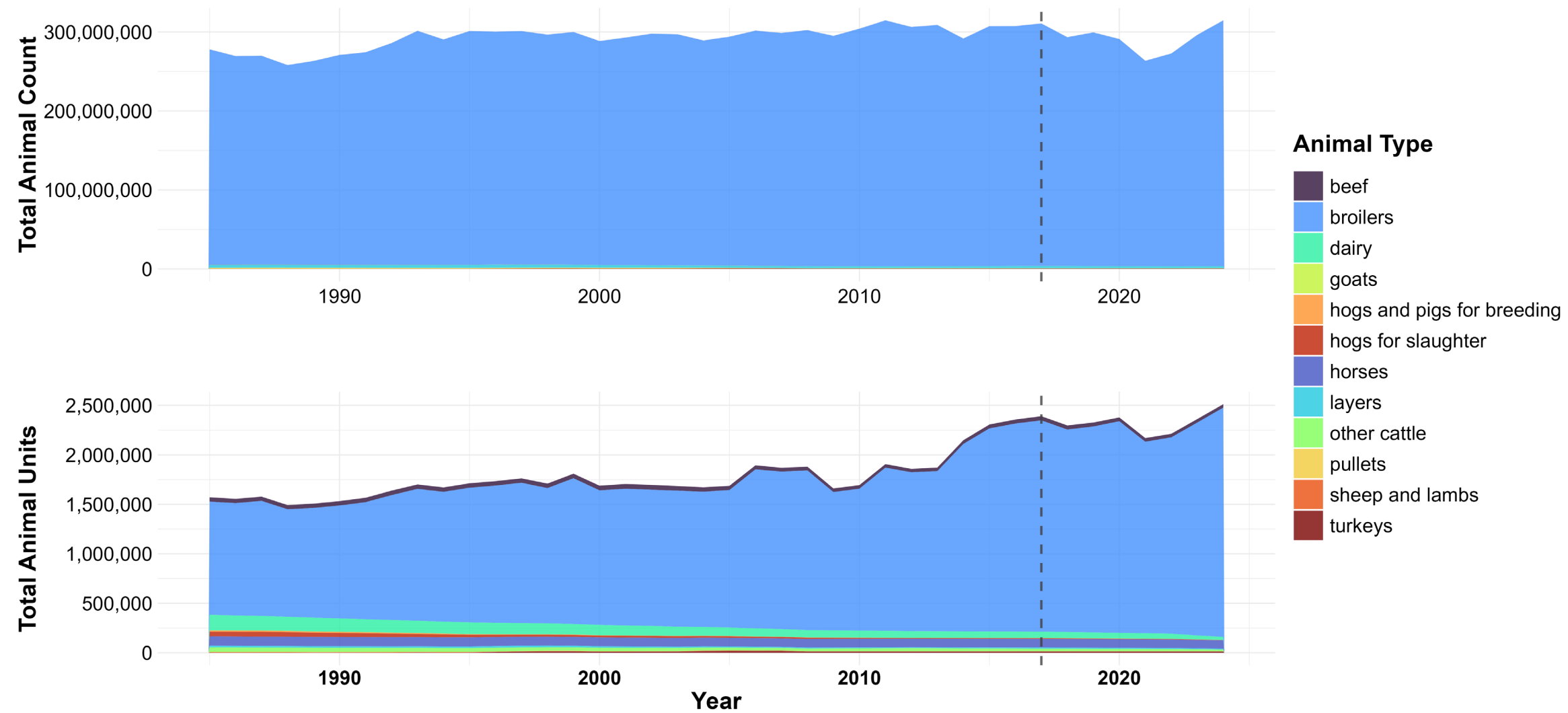
DE - Consolidated State Livestock Summary Profiles

All qualified agricultural counties summed together. Dashed vertical vector marks the year 2017.



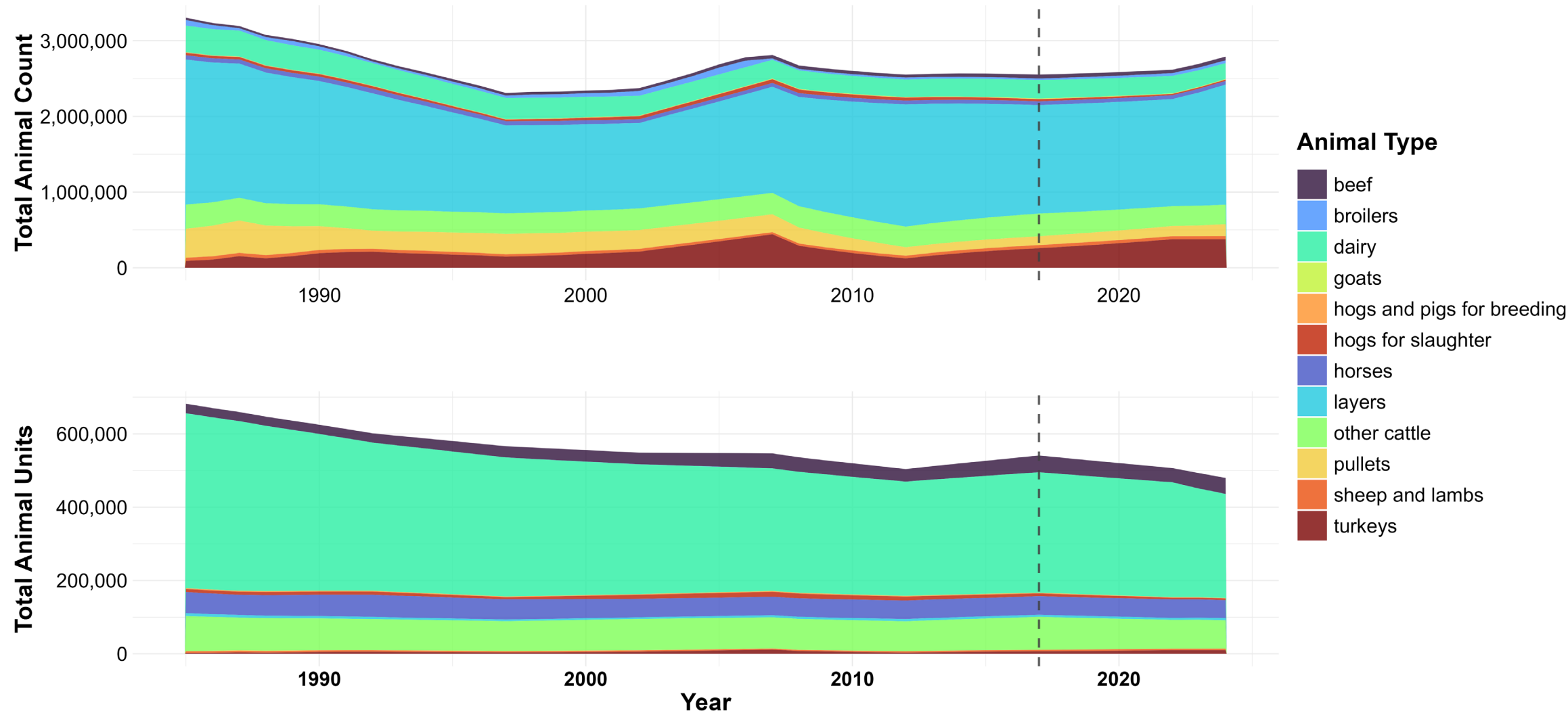
MD - Consolidated State Livestock Summary Profiles

All qualified agricultural counties summed together. Dashed vertical vector marks the year 2017.



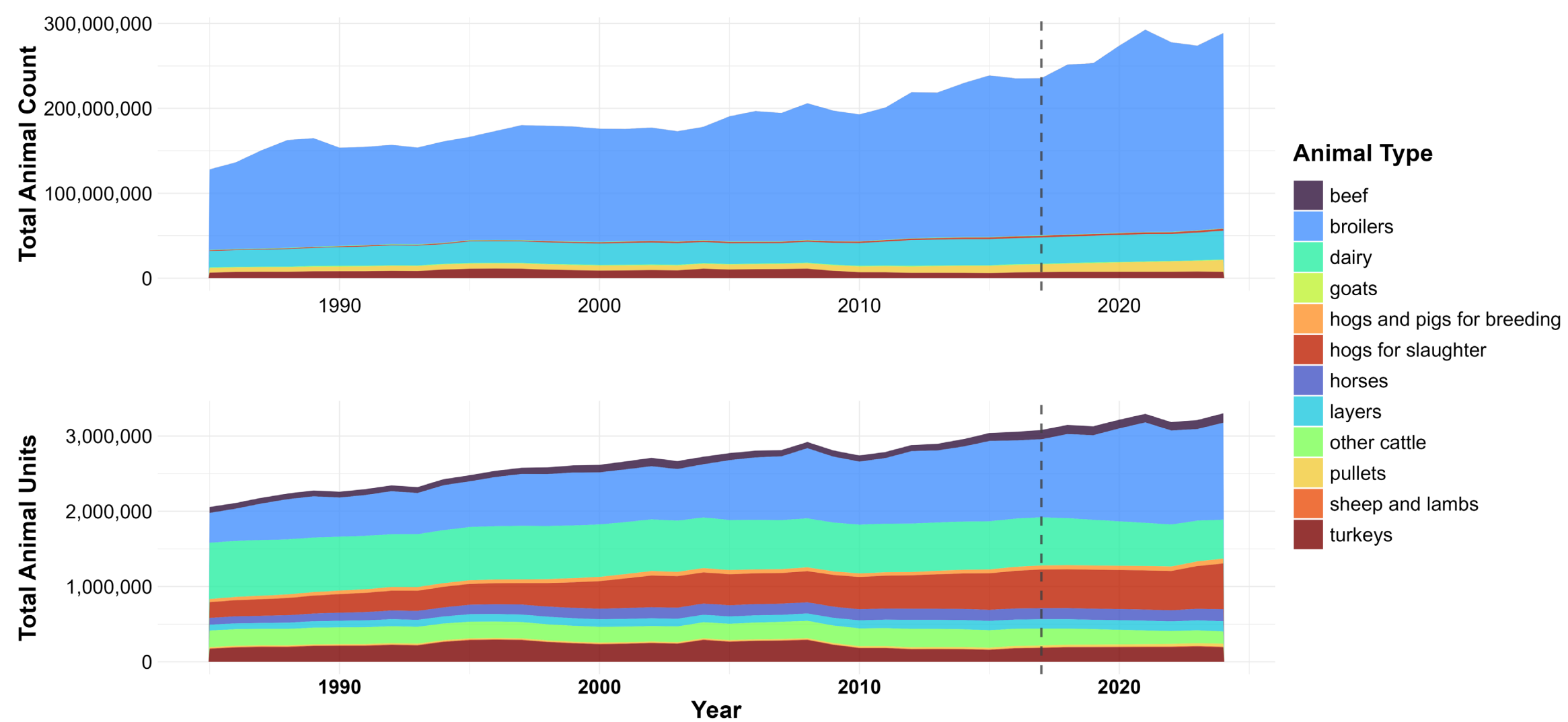
NY - Consolidated State Livestock Summary Profiles

All qualified agricultural counties summed together. Dashed vertical vector marks the year 2017.



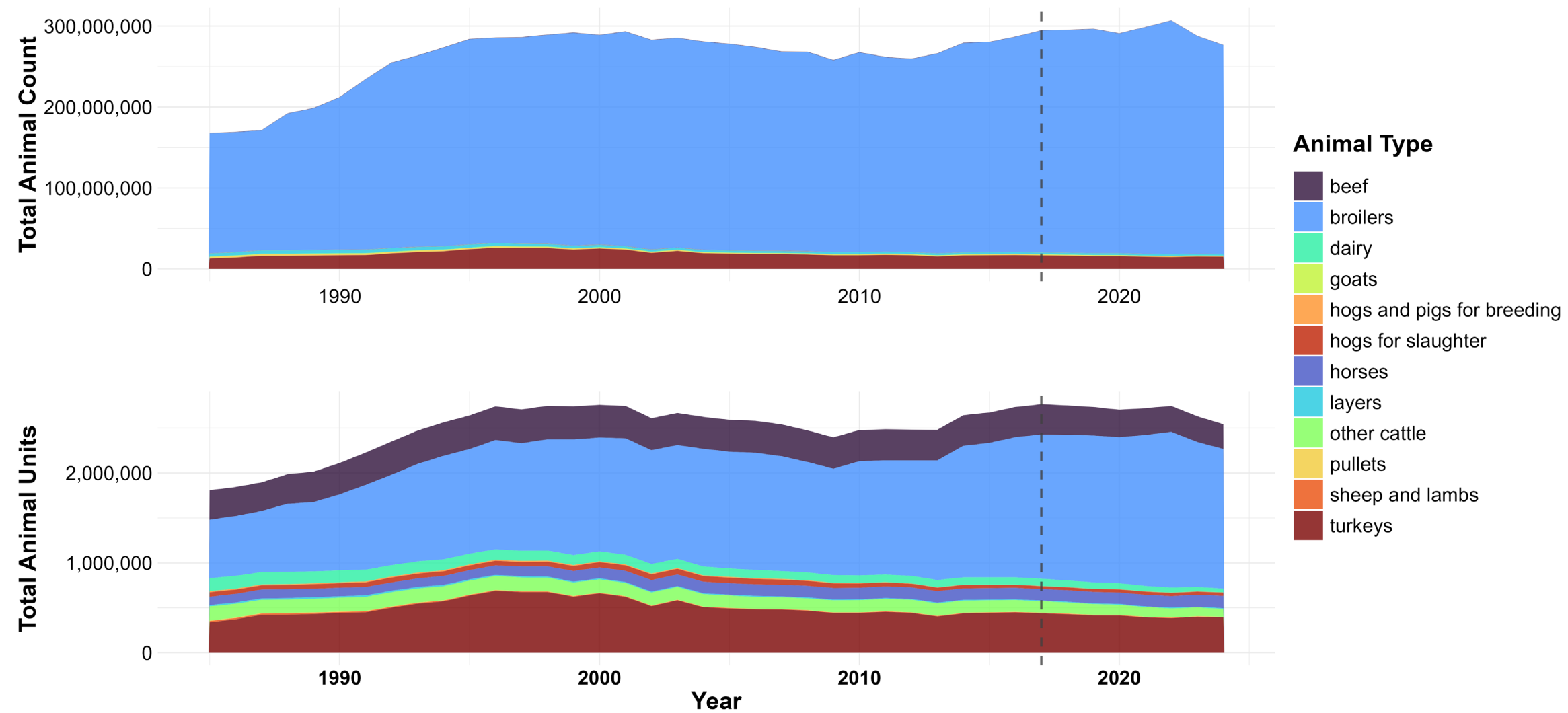
PA - Consolidated State Livestock Summary Profiles

All qualified agricultural counties summed together. Dashed vertical vector marks the year 2017.



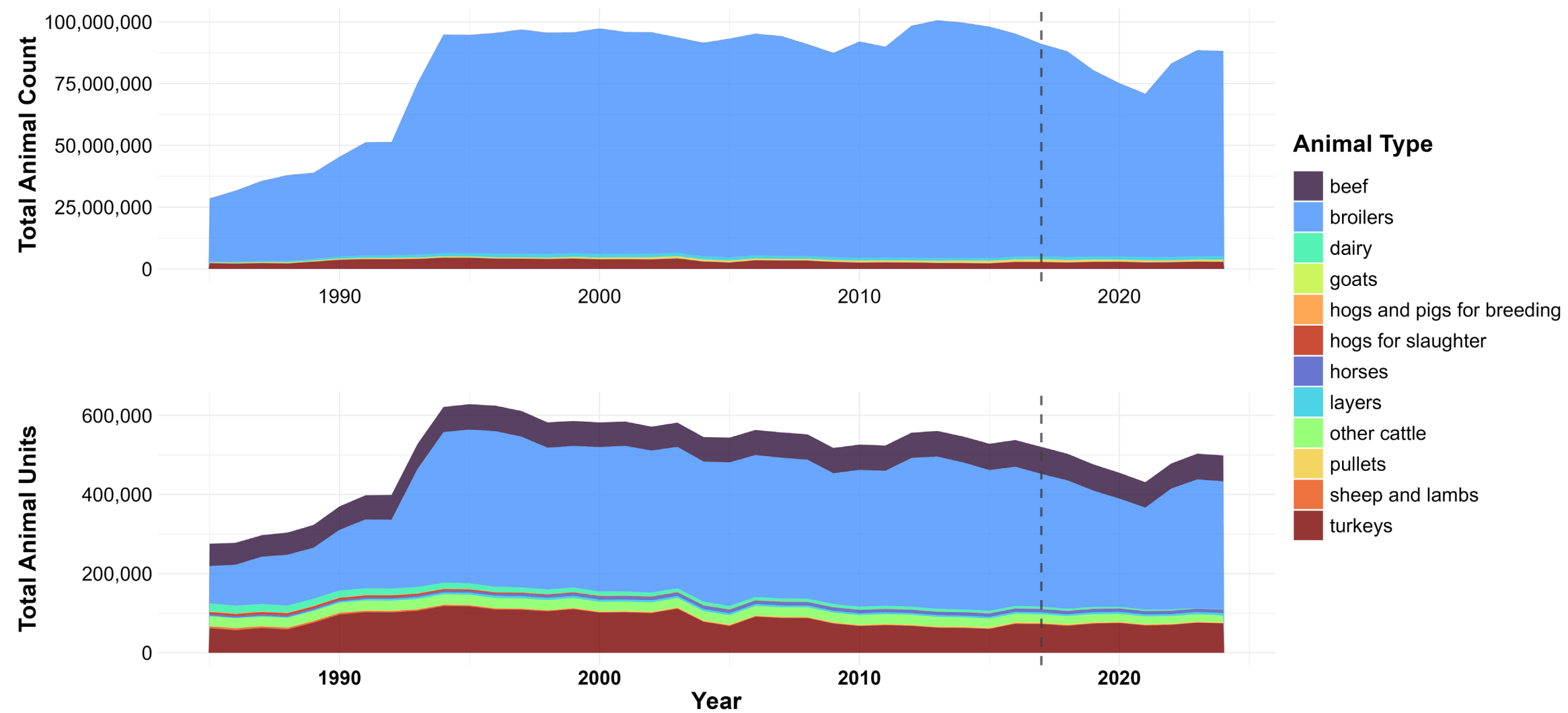
VA - Consolidated State Livestock Summary Profiles

All qualified agricultural counties summed together. Dashed vertical vector marks the year 2017.



WV - Consolidated State Livestock Summary Profiles

All qualified agricultural counties summed together. Dashed vertical vector marks the year 2017.



Summary

- Broilers are the dominant animal in terms of number in all states EXCEPT NY (Layers)
- Animal units (AU), 1000lb of animal do not always reflect the dominant animal
 - E.g. NY has more layers than dairy cattle but due to the weight of dairy cattle more AU's of dairy exist.
- Some states are seeing more animals and others less

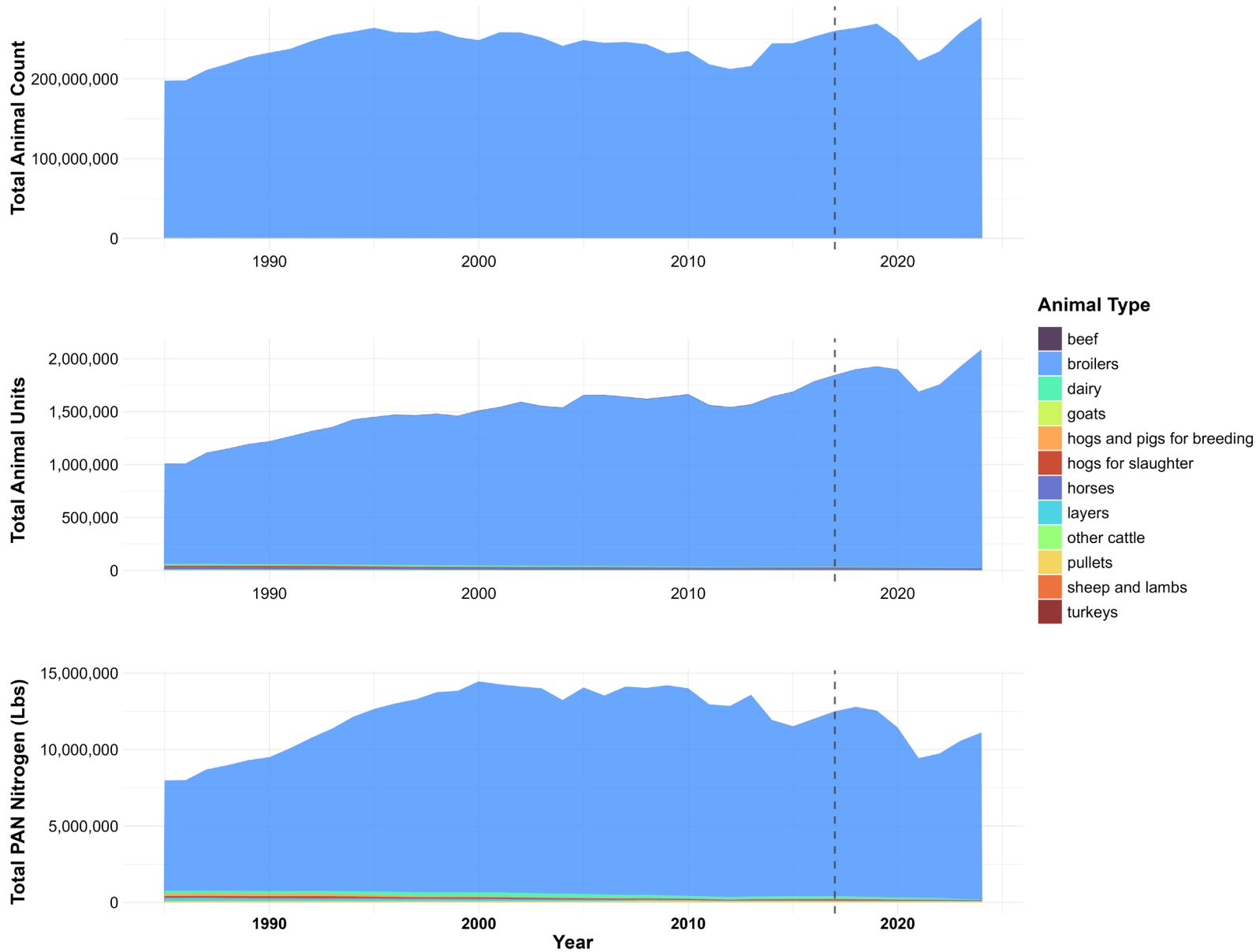
How do animal populations impact nutrients?

Same plots for population and
AU's

New line for Plant Available
Nitrogen from manure

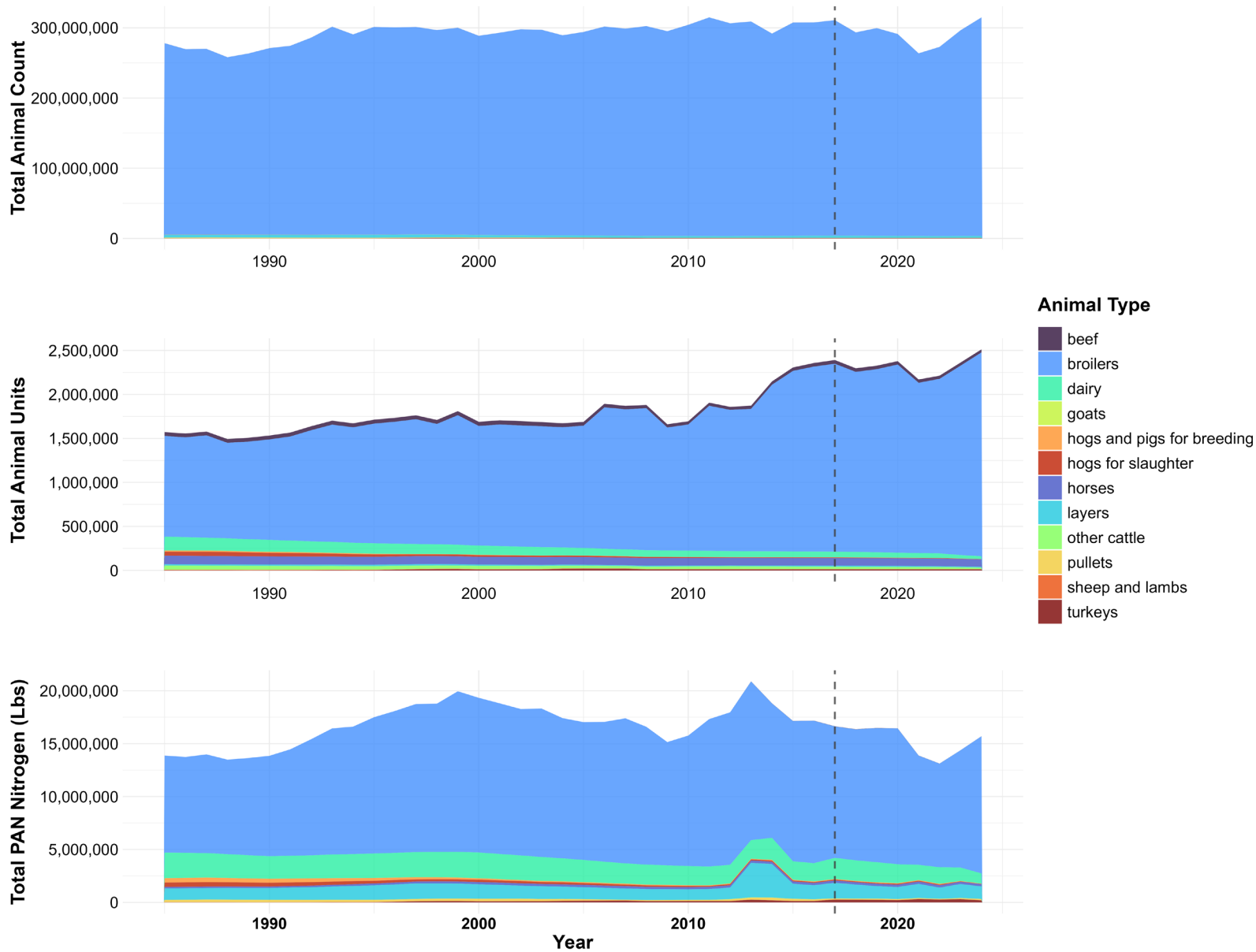
DE - True Statewide Consolidated Summary Profiles

Every agricultural county summed together. Dashed vertical vector marks reference year 2017.



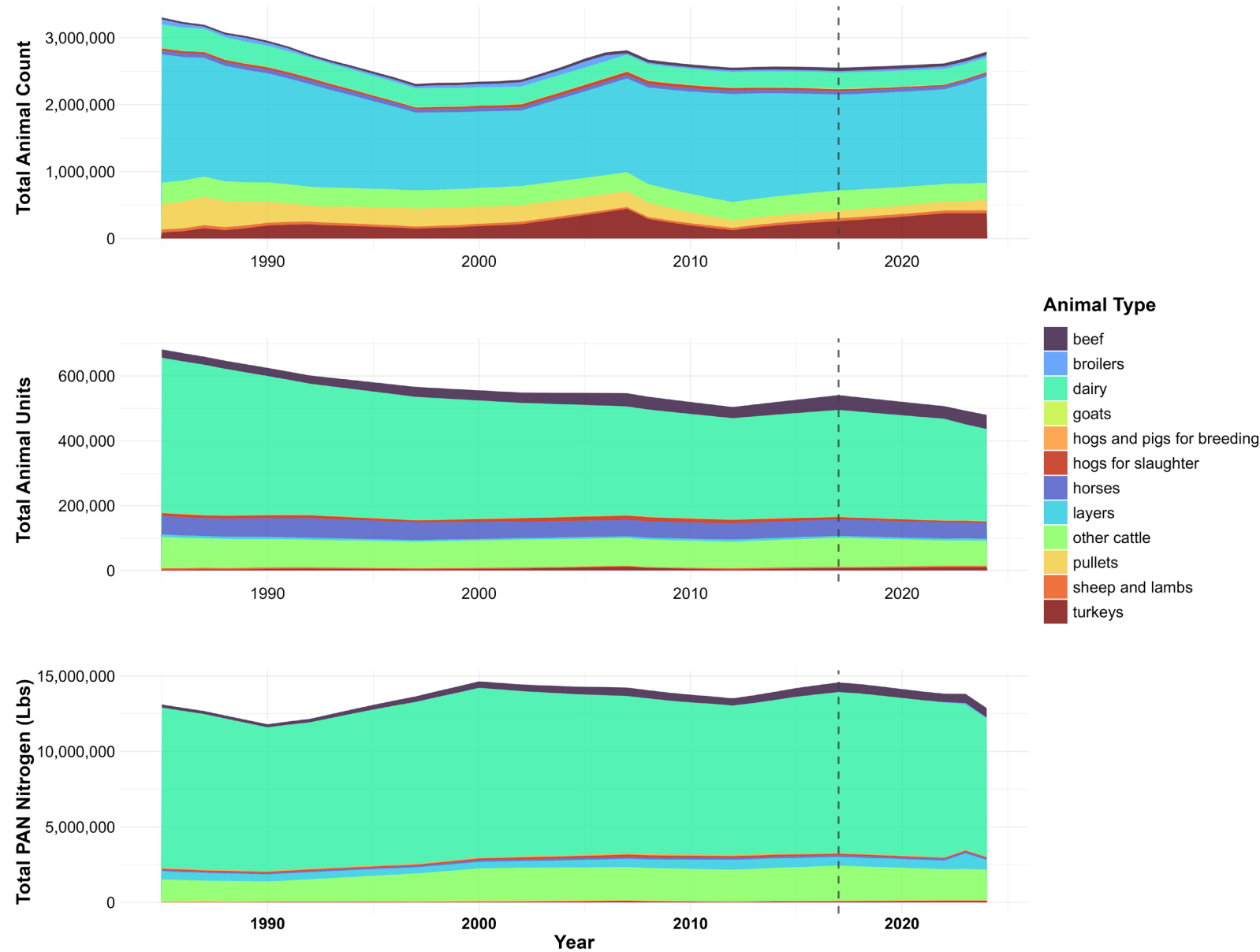
MD - True Statewide Consolidated Summary Profiles

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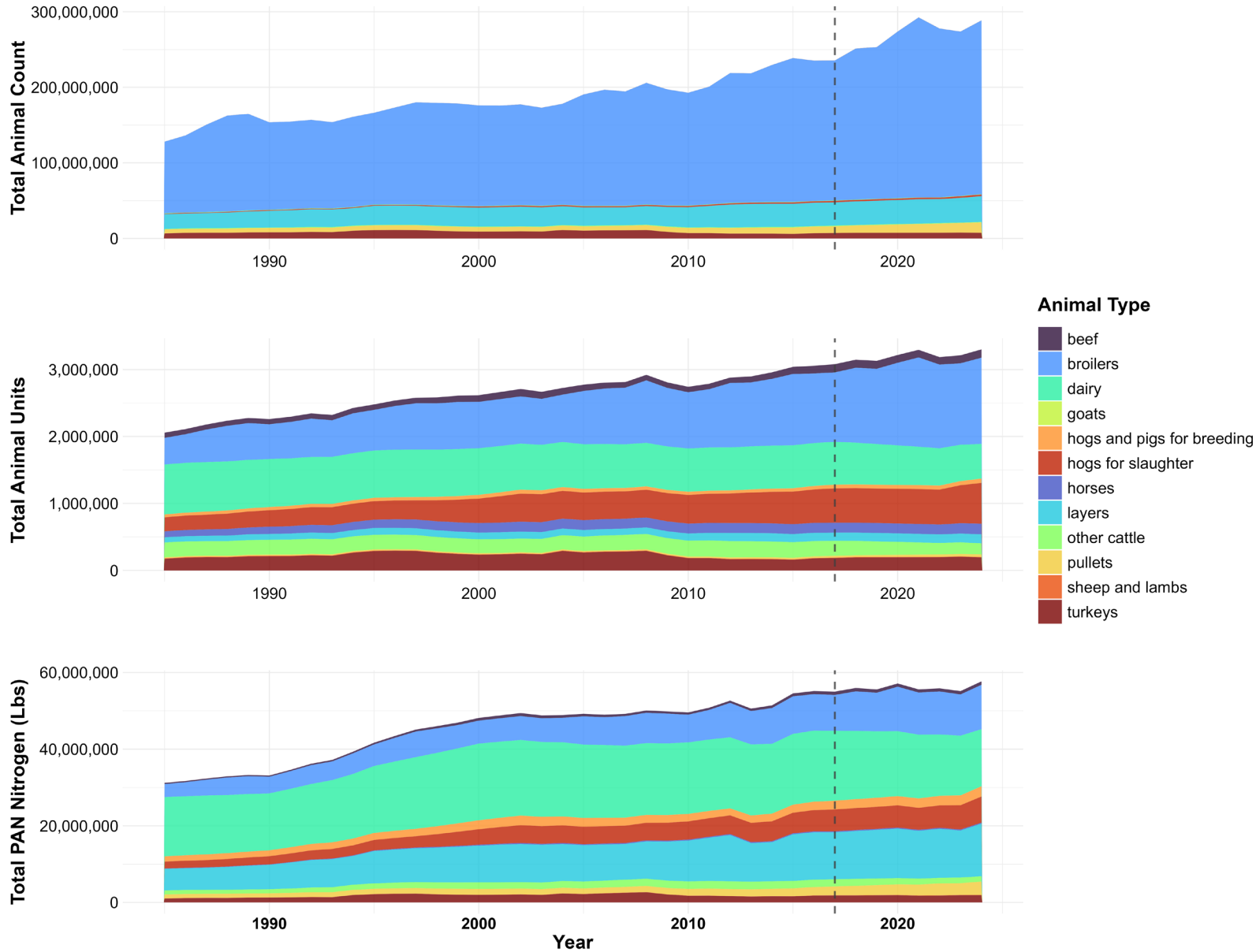
NY - True Statewide Consolidated Summary Profiles

Every agricultural county summed together. Dashed vertical vector marks reference year 2017.



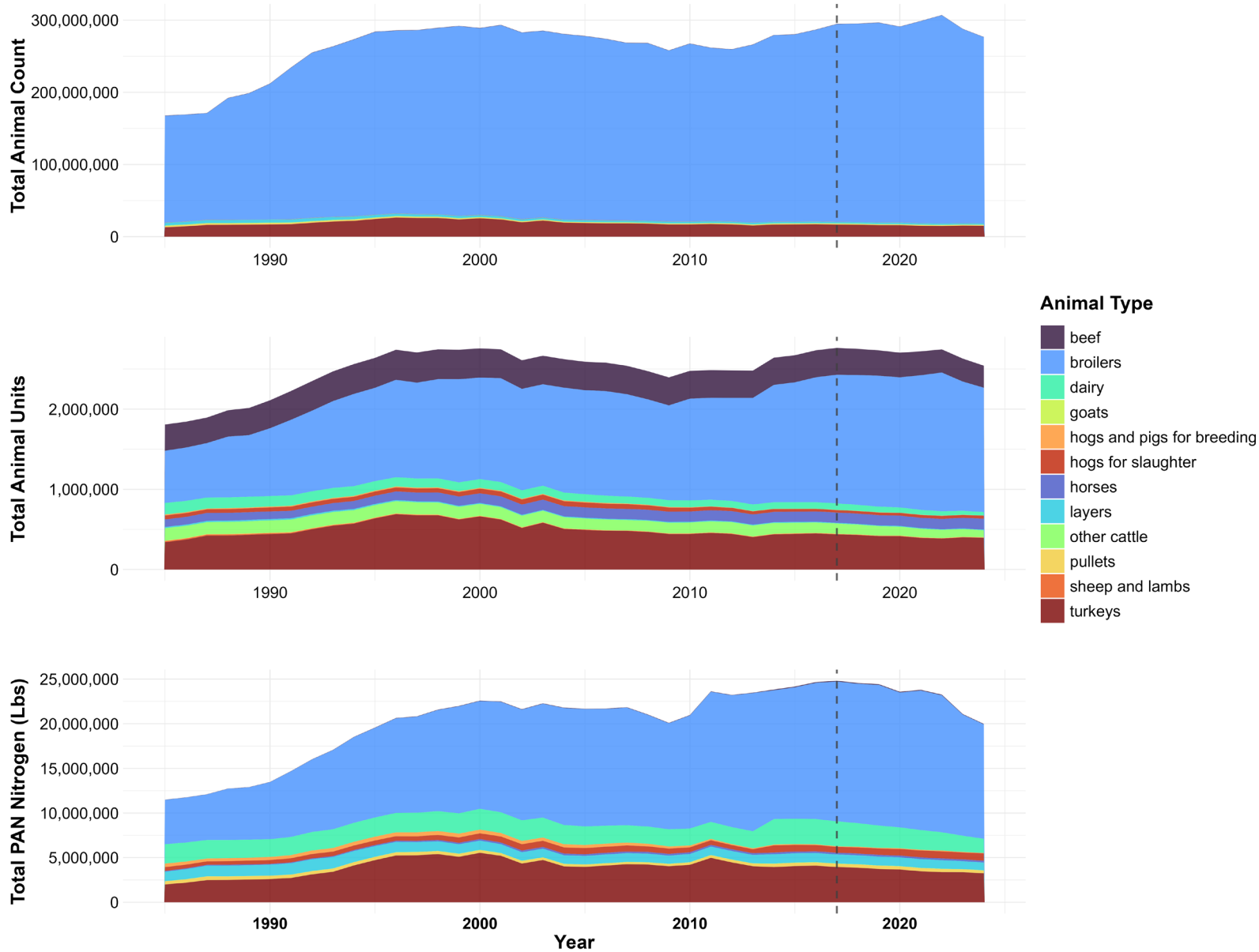
PA - True Statewide Consolidated Summary Profiles

Every agricultural county summed together. Dashed vertical vector marks reference year 2017.



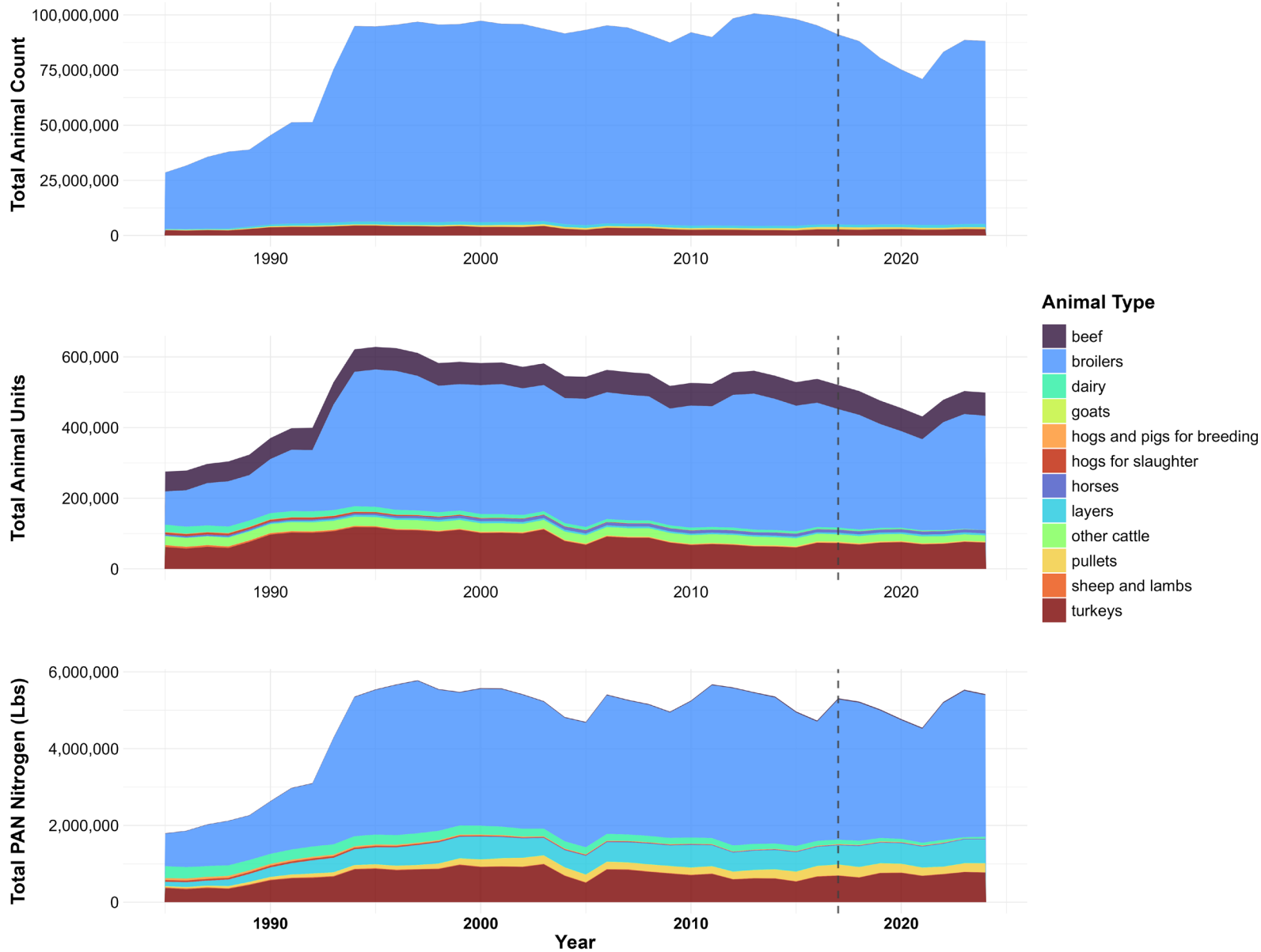
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WV - True Statewide Consolidated Summary Profiles

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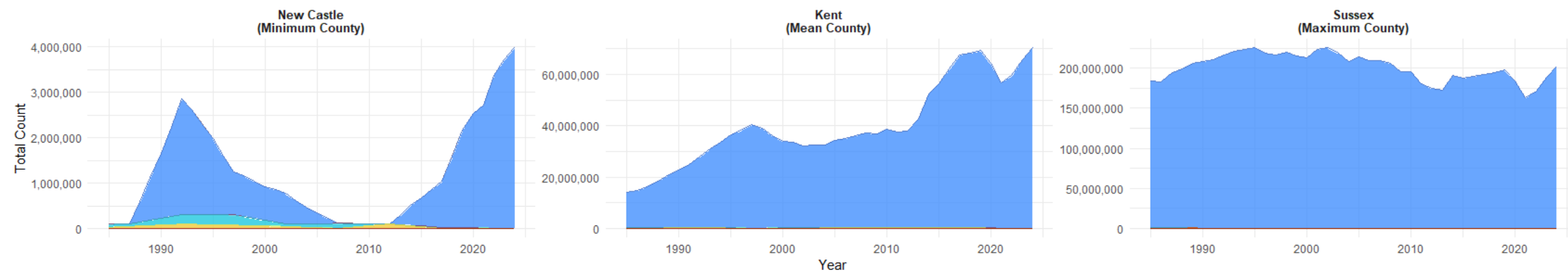
Summary

- Plant Available Nitrogen from manure generally tracks with animal populations
 - More animals/animal units = more PAN

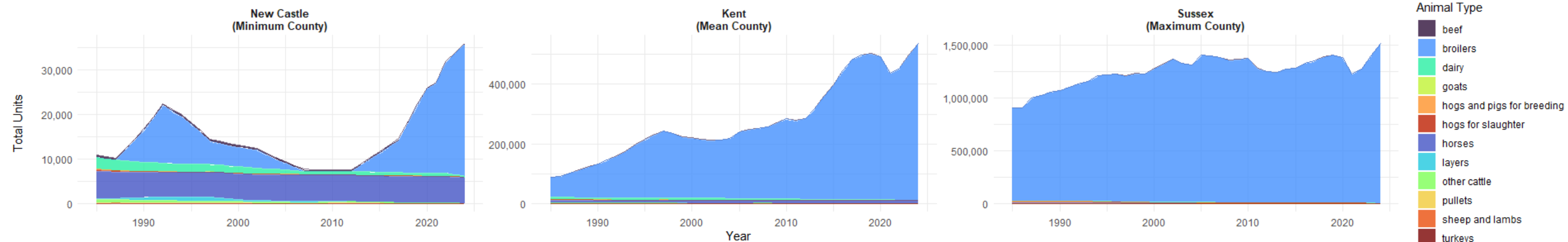
Let's take a “representative” look at each state

- Plant Available Nitrogen from the Stored Nitrogen pool
- State summaries
 - Three counties
 - Minimum PAN
 - Mean PAN
 - Max PAN
 - Each county has the animal population, AU's, and stored N
- *NOTE Cities were excluded for the purpose of this analysis

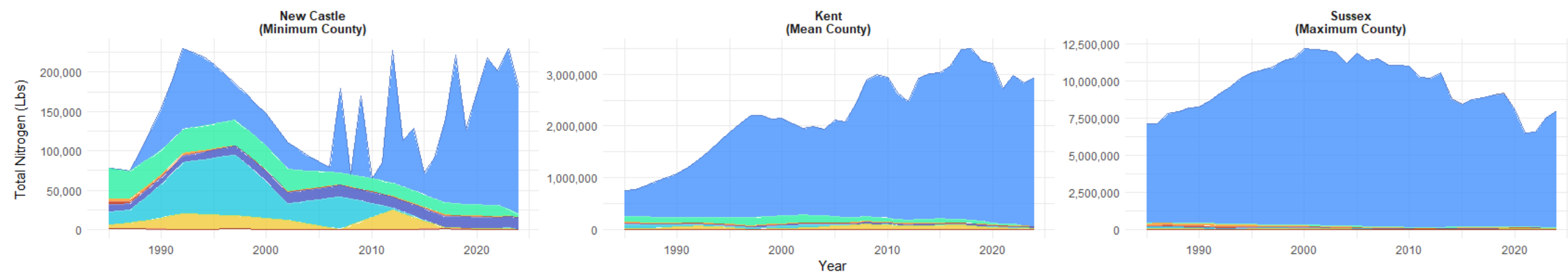
DE - Plant Available Stored Animal Count



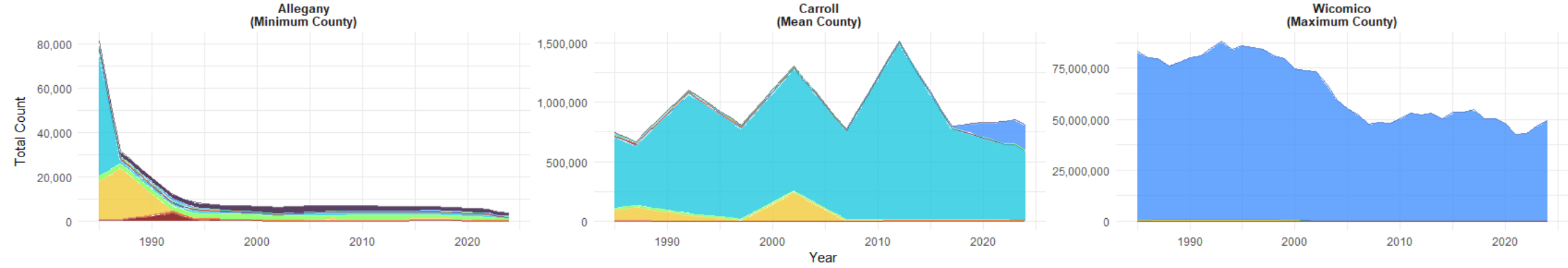
DE - Plant Available Stored Animal Units



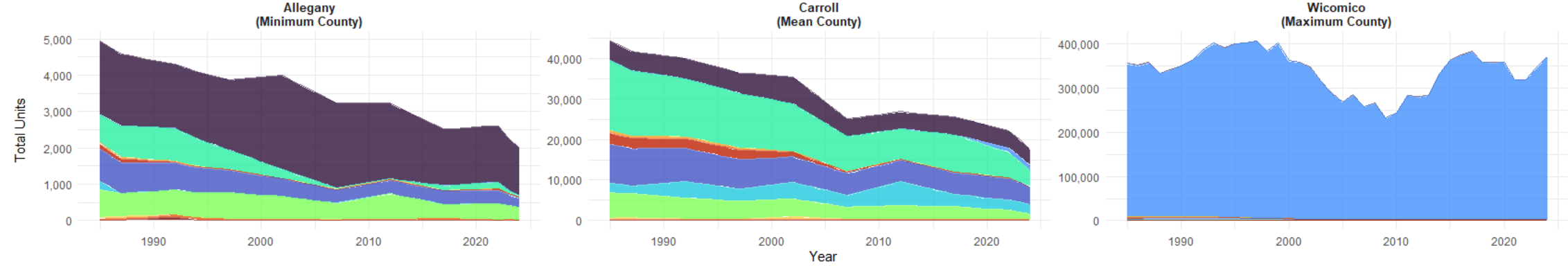
DE - Plant Available Stored Nitrogen



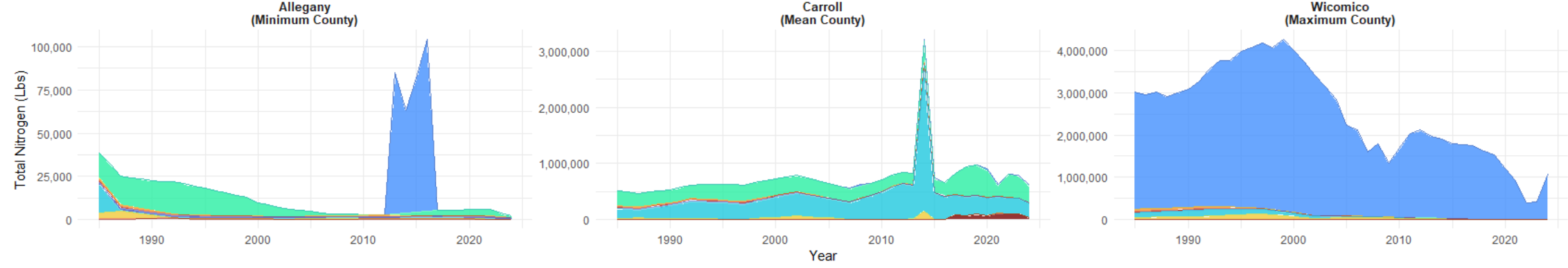
MD - Plant Available Stored Animal Count



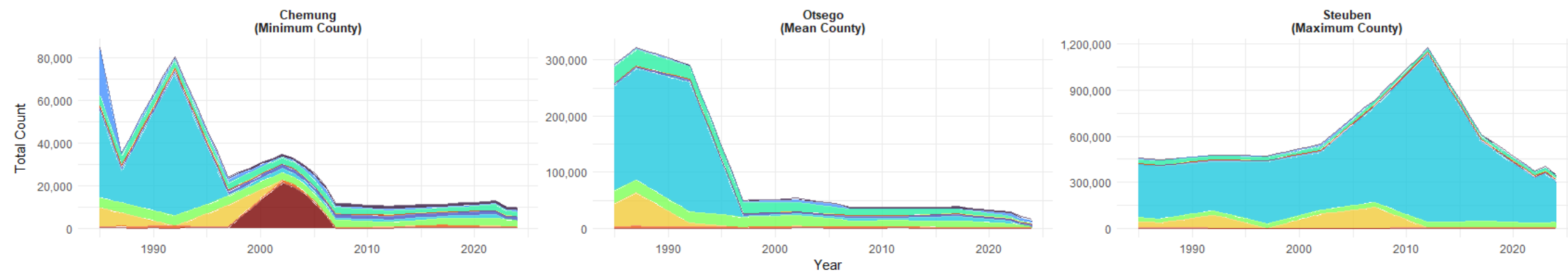
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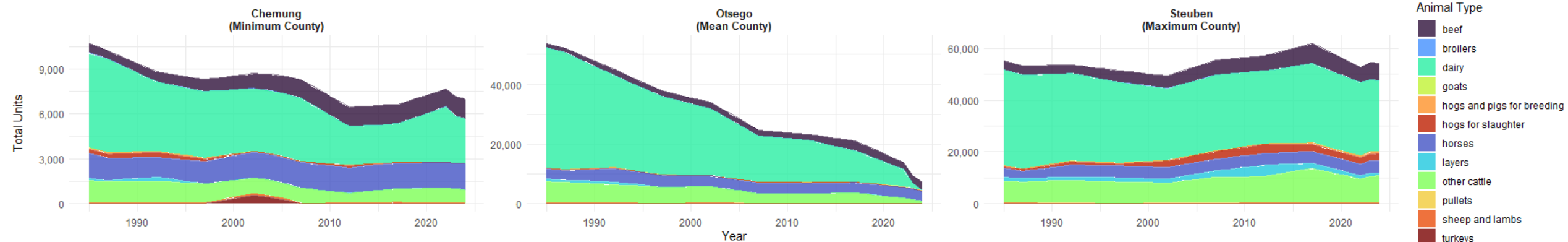
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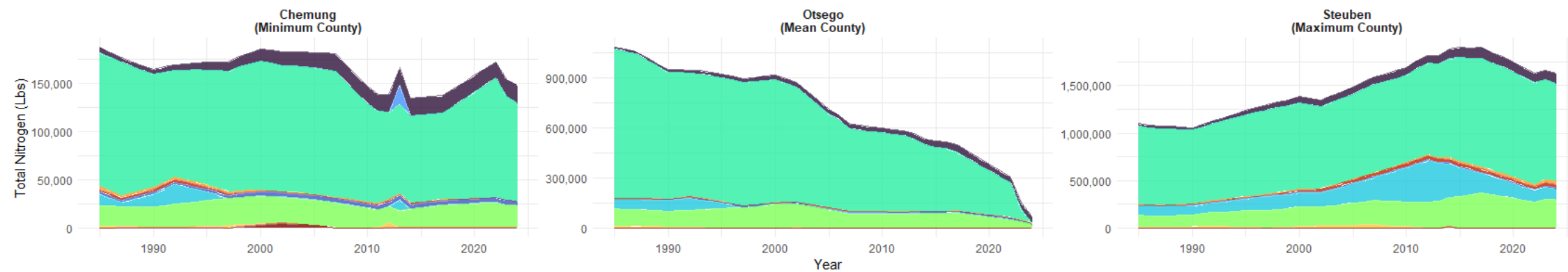
NY - Plant Available Stored Animal Count



NY - Plant Available Stored Animal Units



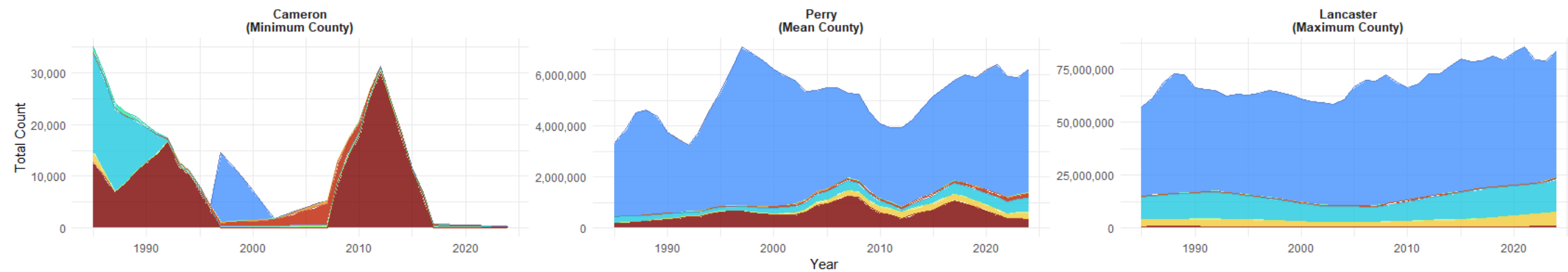
NY - Plant Available Stored Nitrogen



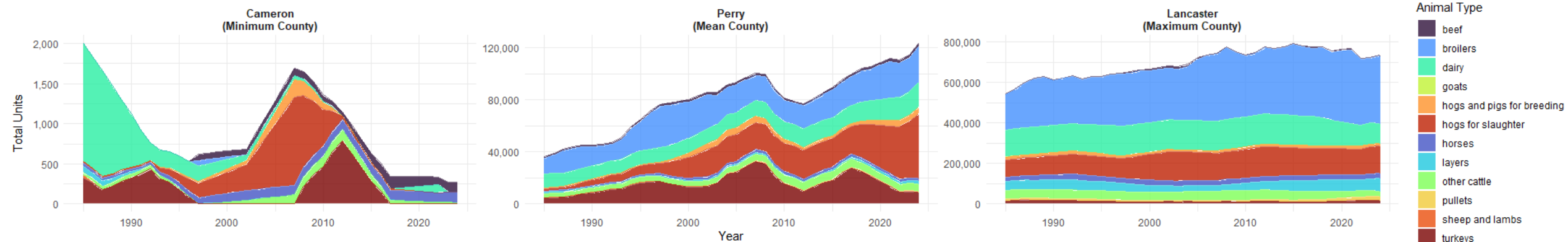
Animal Type

- beef
- broilers
- dairy
- goats
- hogs and pigs for breeding
- hogs for slaughter
- horses
- layers
- other cattle
- pullets
- sheep and lambs
- turkeys

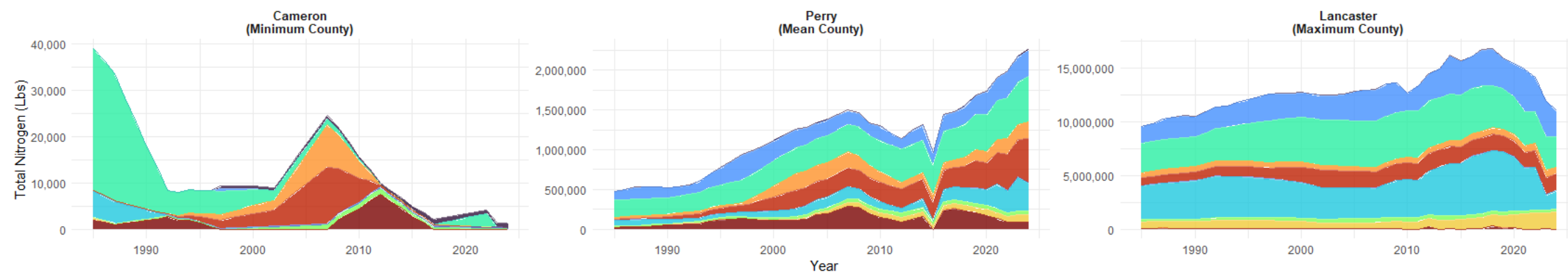
PA - Plant Available Stored Animal Count



PA - Plant Available Stored Animal Units



PA - Plant Available Stored Nitrogen

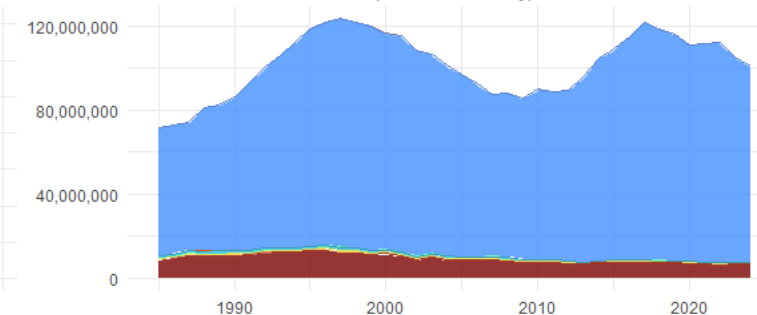
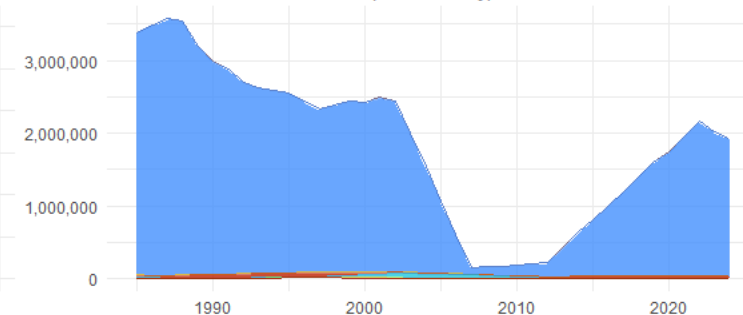
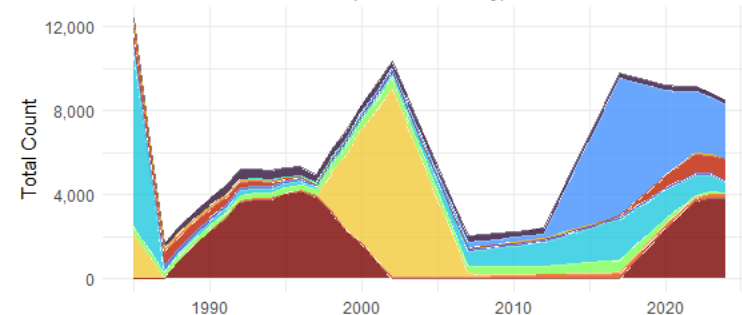


VA - Plant Available Stored Animal Count

New Kent
(Minimum County)

Isle Of Wight
(Mean County)

Rockingham
(Maximum County)

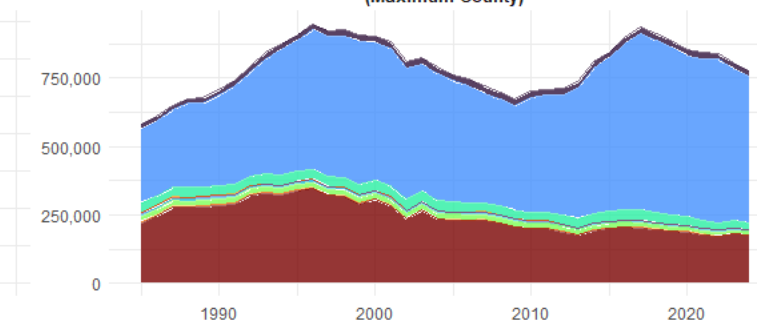
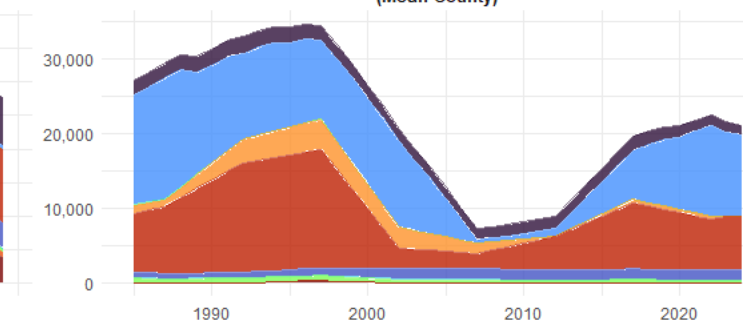
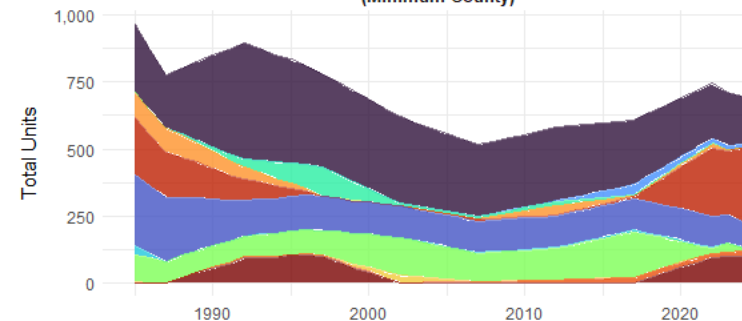


VA - Plant Available Stored Animal Units

New Kent
(Minimum County)

Isle Of Wight
(Mean County)

Rockingham
(Maximum County)



Animal Type

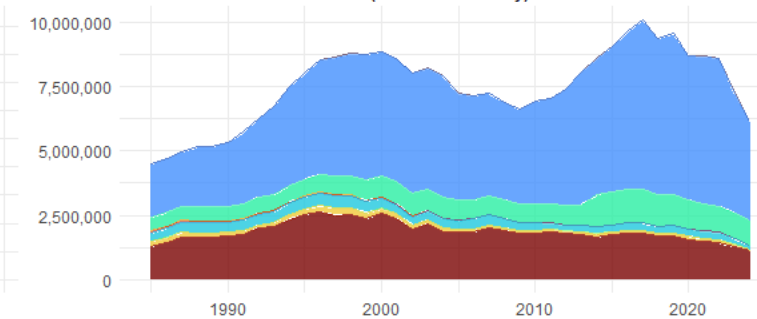
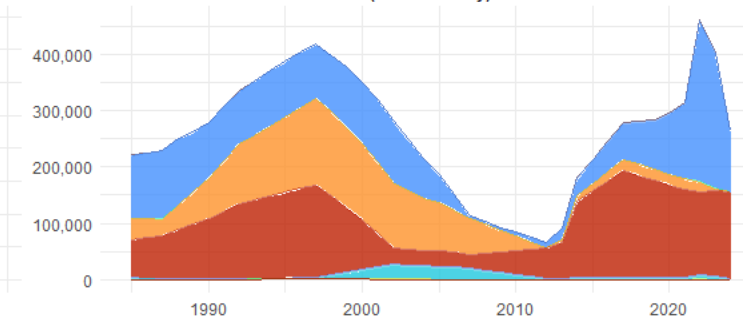
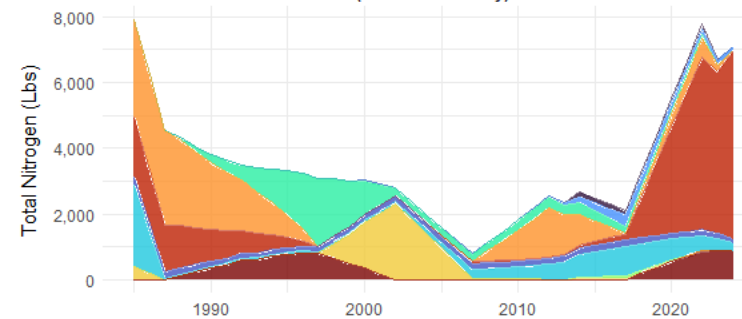
- beef
- broilers
- dairy
- goats
- hogs and pigs for breeding
- hogs for slaughter
- horses
- layers
- other cattle
- pullets
- sheep and lambs
- turkeys

VA - Plant Available Stored Nitrogen

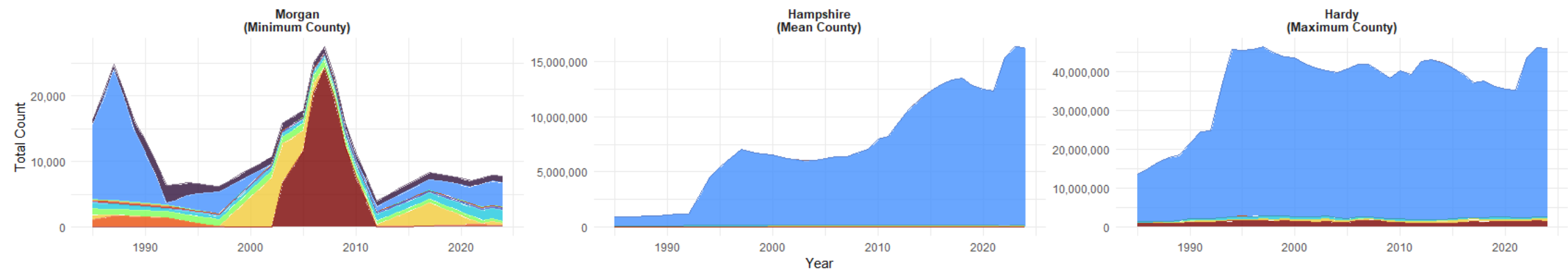
New Kent
(Minimum County)

Isle Of Wight
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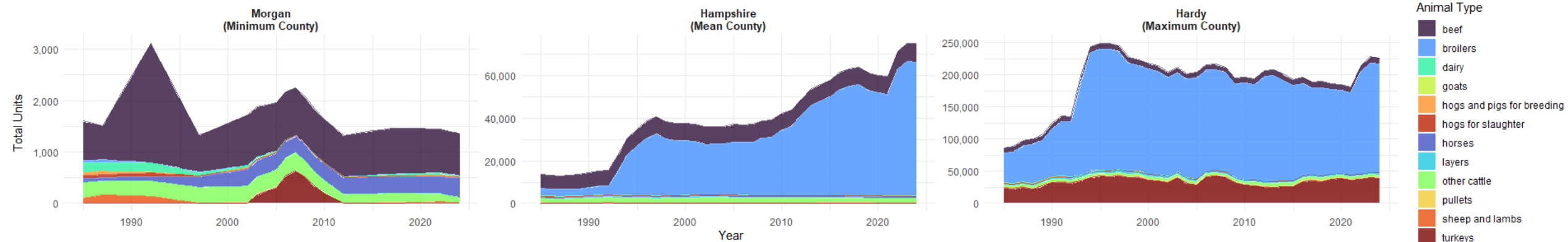
Rockingham
(Maximum County)



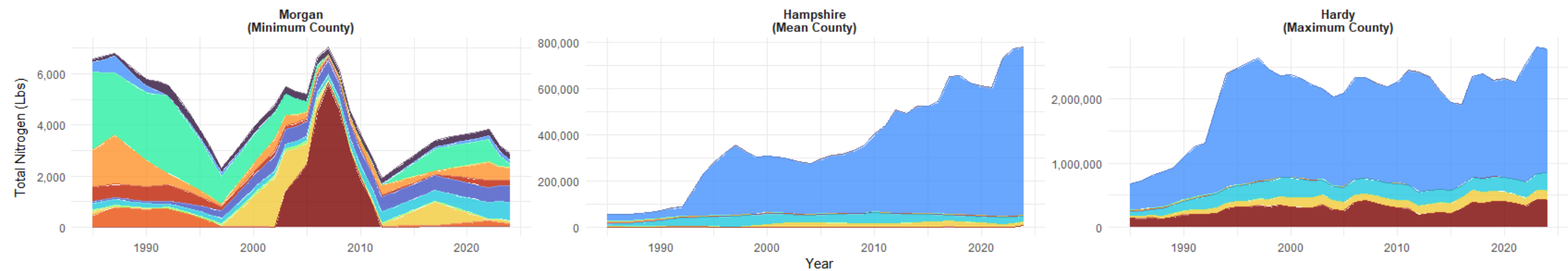
WV - Plant Available Stored Animal Count



WV - Plant Available Stored Animal Units



WV - Plant Available Stored Nitrogen



Summary

- Counties within a state can behave very differently
- Within the same county interannual variability can lead to swings in manure availability
- It is very difficult to understand why something is happening without the details

Questions?

Discussion:

- Do you see places where you feel animal populations don't match your expectation?
- What about manure nutrients?