Development, implementation, and future perspectives of health evaluations in the U.S.

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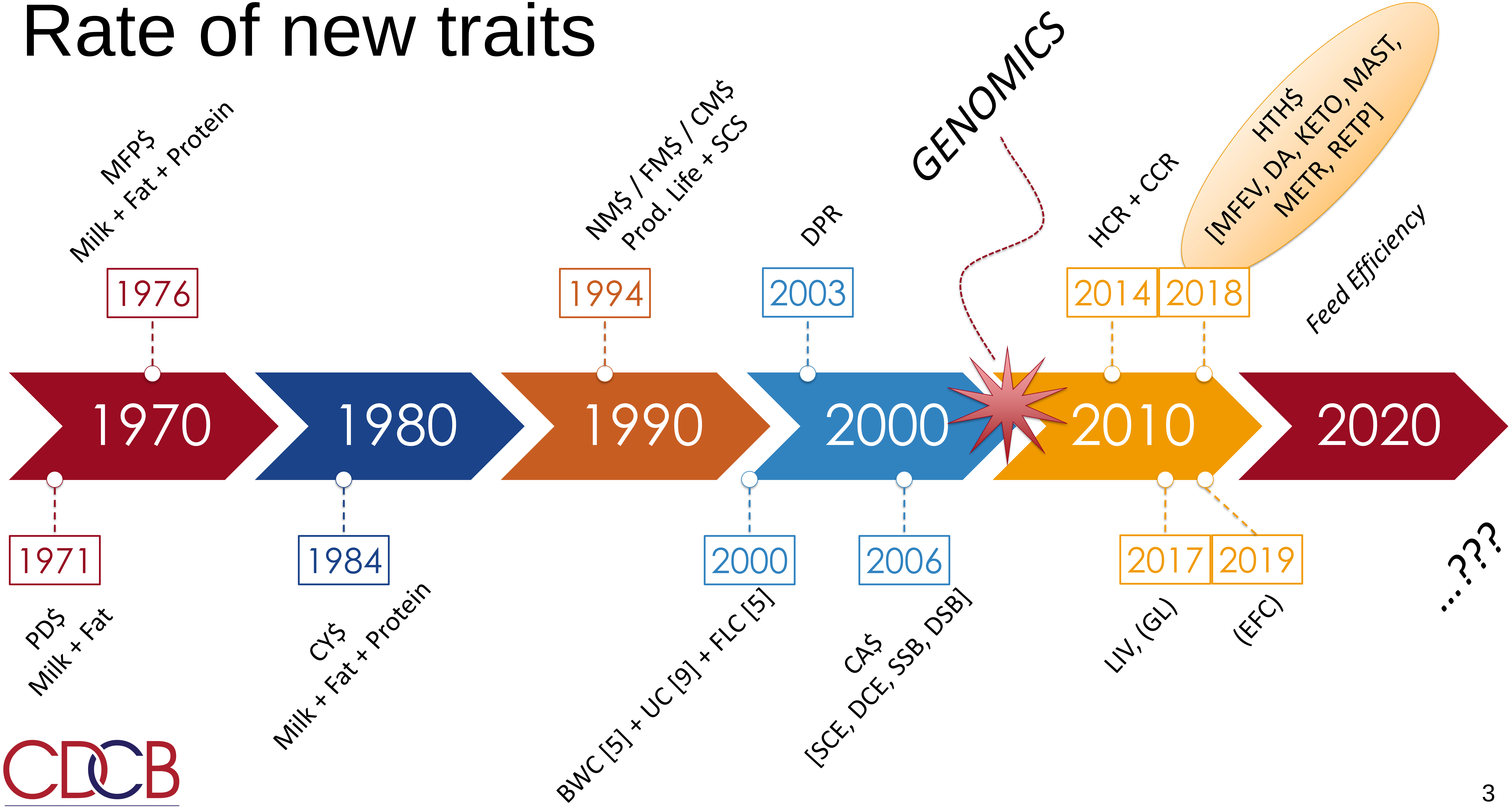
DEVELOPMENT

Rate of new traits



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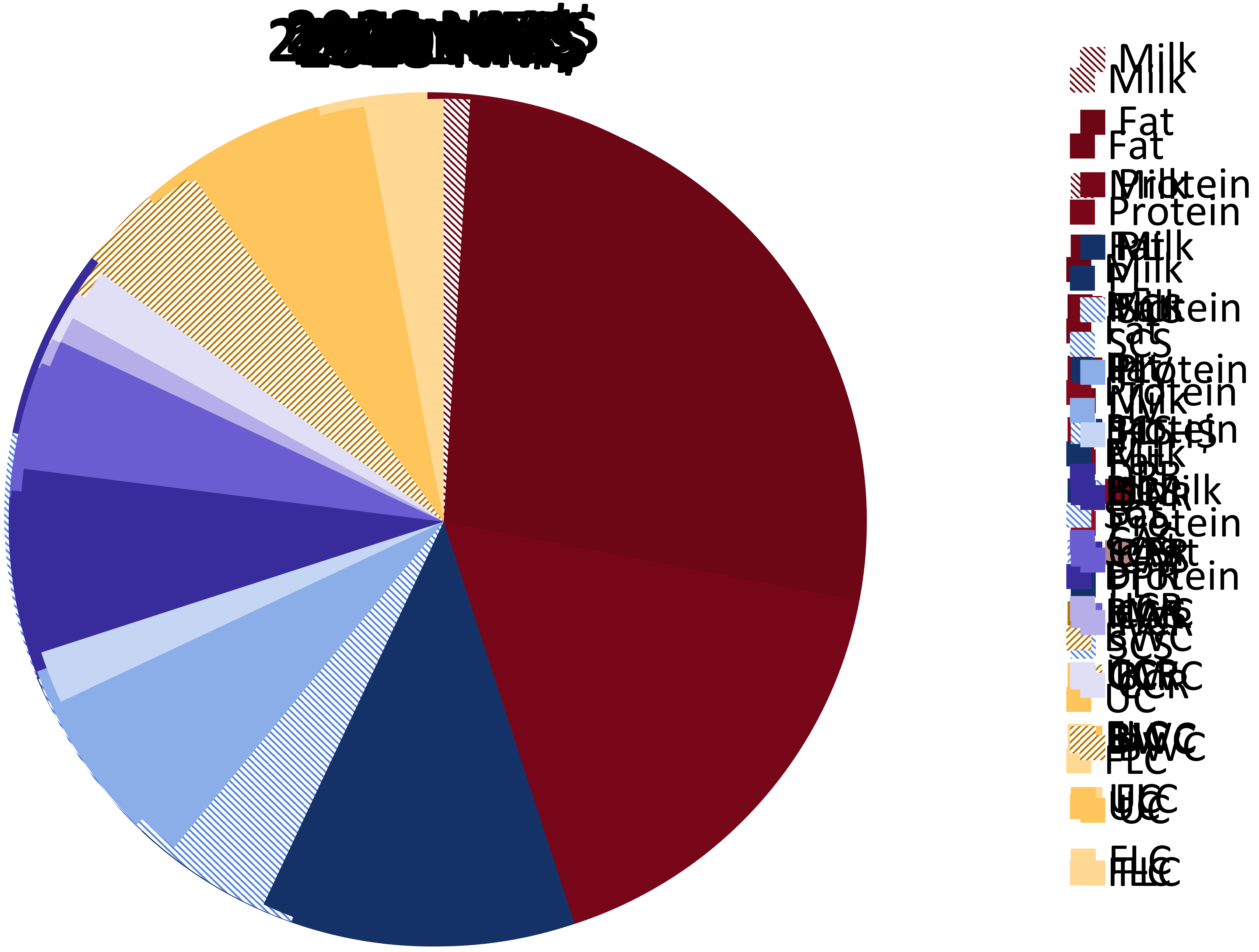
Changes in emphasis over time

Production

Health

Reproduction

Type



* Striped segments indicate negative weights in the index

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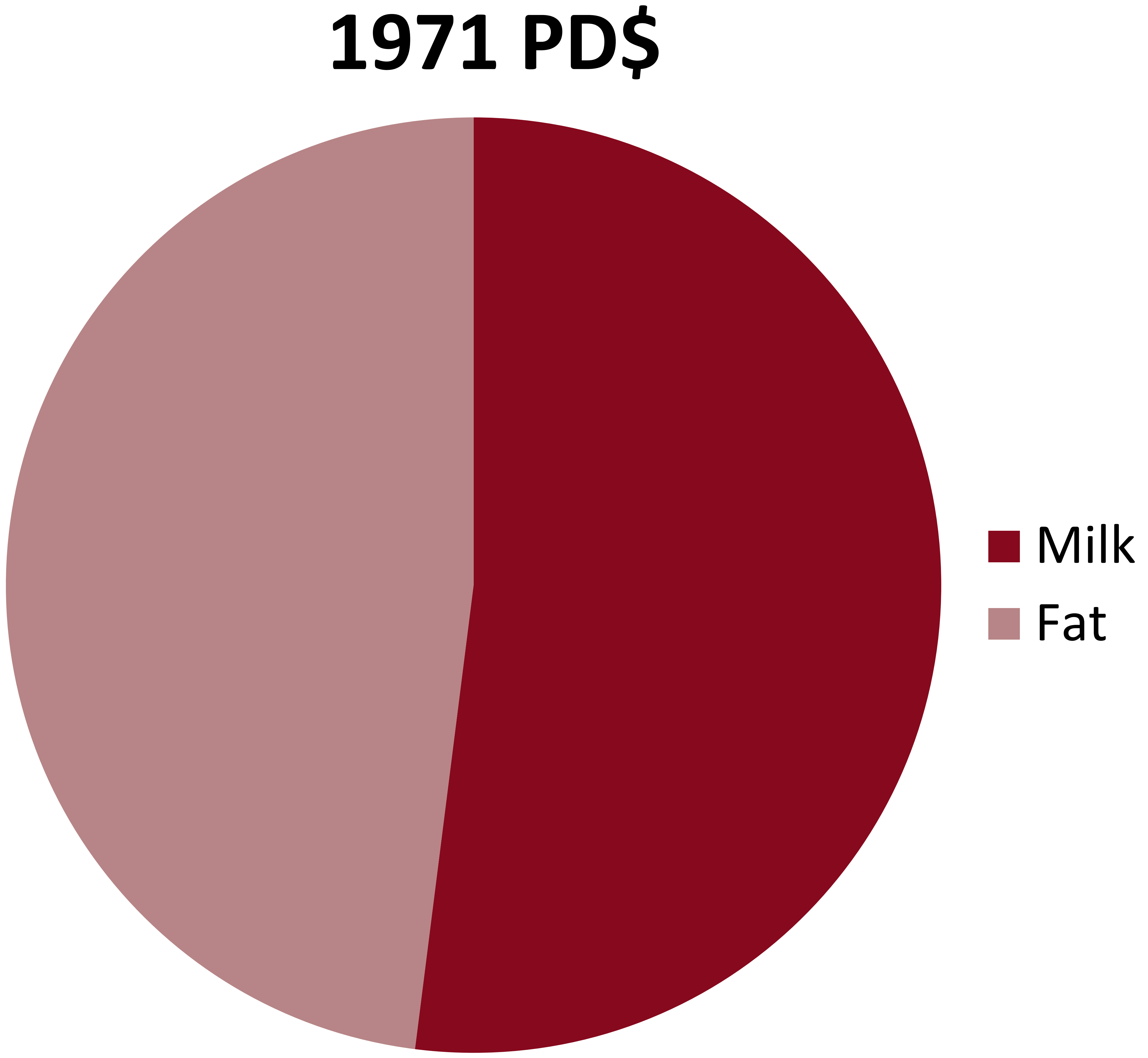
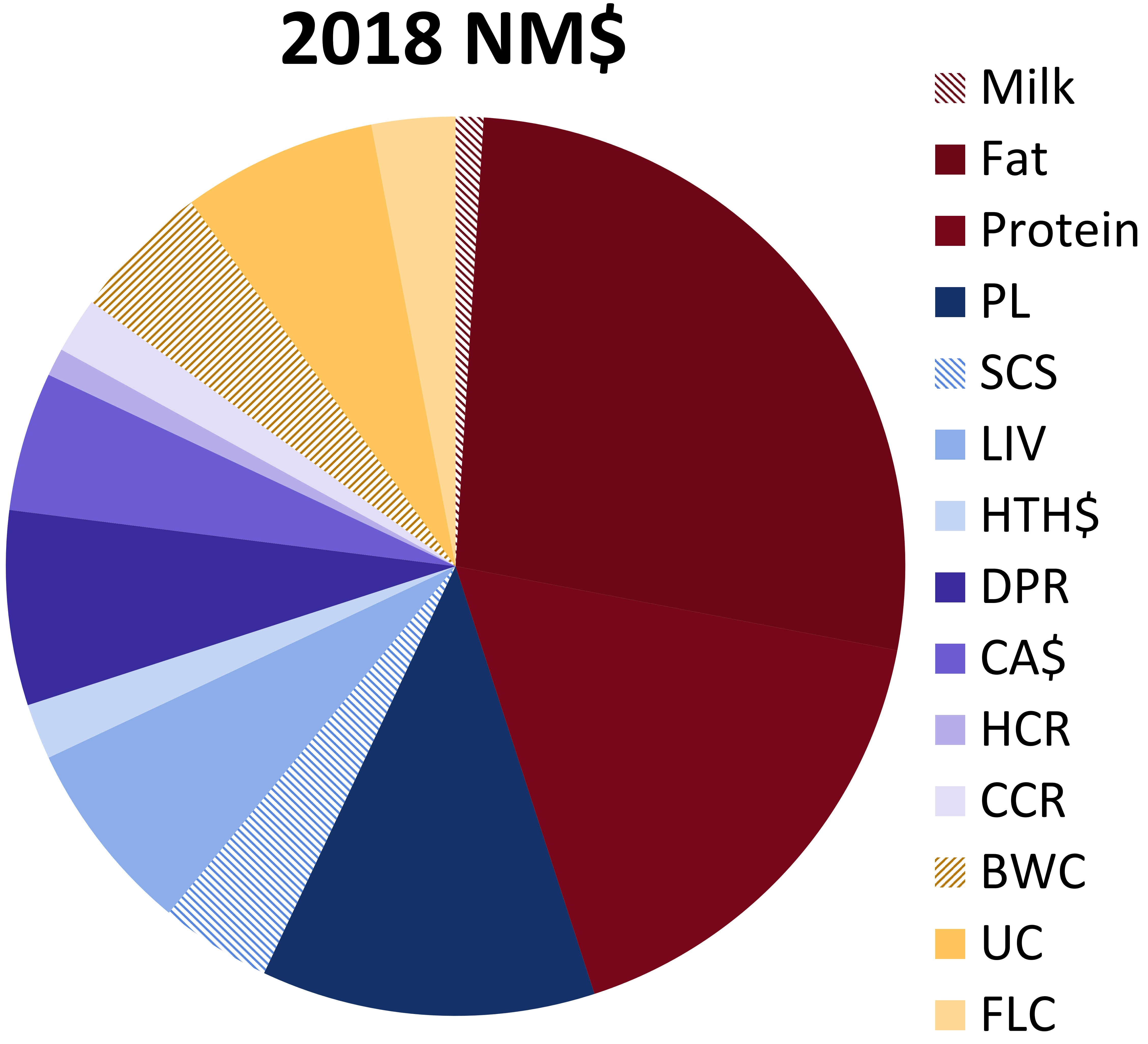
Changes in emphasis over time





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Since the 1980s

- Evidence that selection for health events could be successful
  - E.g., Scandinavian countries – direct recording of health events
- Within U.S. – calls for a unified system of reporting health events
  - Possibility for improvement through selection
  - Since 1994 – Indirect selection through traits SCS and PL, and later LIV

- **Introduction of genomics in 2009** – feasible to select for lowly heritable traits that are expensive and/or difficult to measure

U.S. hurdles

- No mandated reporting system
- Need a single repository to collect and store data
- No unified way to record health events
  - Standardization critical

(https://www.thesun.co.uk/news/3420620/showjumping-cow-jumps-hurdles-pictures/)

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Data flow

- Cooperation from the Dairy Records Processing Centers
  - Flow through DHI system
- Necessary standardization performed by DRPCs

Format 6

Includes 20 health event codes + 4 management codes

					Health Event Segments (up to 20 segments)
Health Event Segment Block (# 1)					
138-141	4	AAAA	CH	170	Health event code
142-149	8	XX..XX	CH		Health event date (YYYYMMDD)
150	1	A	CH		Health event date type (A = actual; E = estimated)
151-156	6	AA..AA	CH		Health event detail
157-175	19	AA..AA	CH		Health event segment block # 2
176-194	19	AA..AA	CH		Health event segment block # 3
195-213	19	AA..AA	CH		Health event segment block # 4

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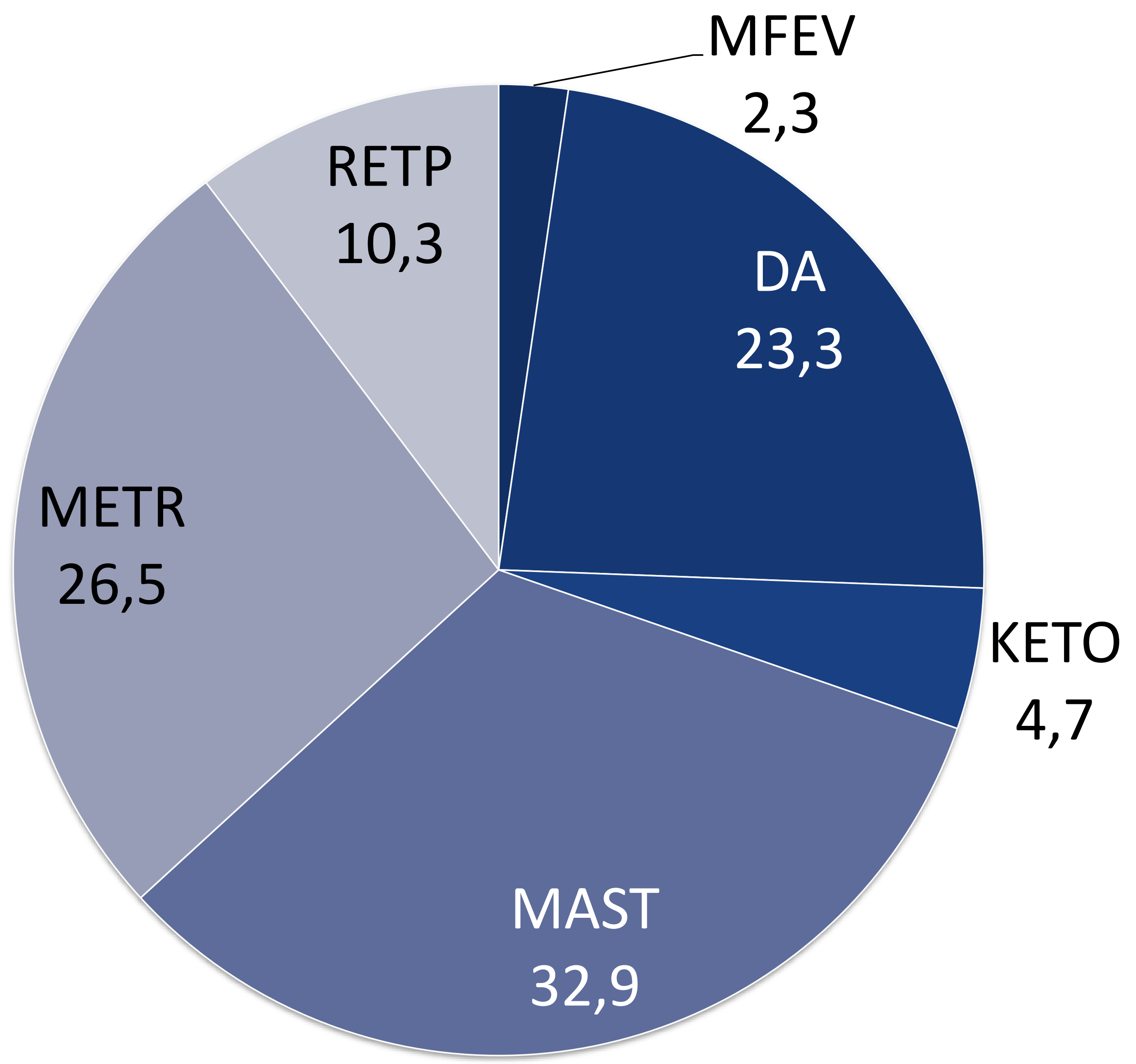
IMPLEMENTATION

Health trait implementation

- April 2018: Official genomic evaluations for 6 direct health traits from CDCB for Holstein
  - Milk fever (MFEV)
  - Displaced abomasum (DA)
  - Ketosis (KETO)
  - Mastitis (MAST)
  - Metritis (METR)
  - Retained placenta (RETP)

- August 2018: Inclusion of health trait sub-index (HTH$) in net merit indices (NM$, FM$, CM$, GM$)
  - 2.3% total emphasis within NM$



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Data processing

- Two levels of editing at CDCB
  - General edits – date checks, parent checks, herd checks, etc.
  - Constraints to be included for genetic evaluation – parities 1 to 5, Holstein (currently), minimum/maximum incidence restrictions, etc.

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Phenotypes used for evaluation

	Number of Records	Number of Cows
Milk fever	1.2 M	0.7 M
Displaced abomasum	1.9 M	1.1 M
Ketosis	1.4 M	0.8 M
Mastitis	2.4 M	1.4 M
Metritis	2.0 M	1.1 M
Retained placenta	2.2 M	1.3 M

*As of April 2019 evaluation

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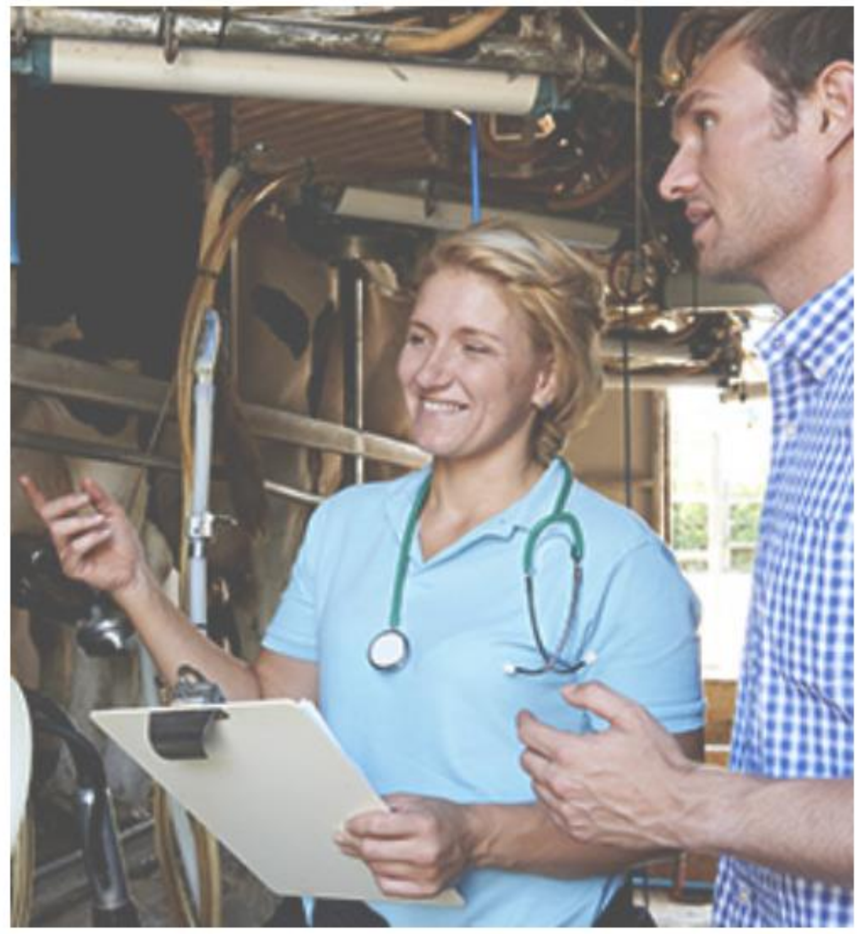
Evaluation models

- Single-trait linear animal repeatability models
- Additional details available

https://www.uscdcb.com/

	Heritability (observed)
Milk fever	0.6%
Displaced abomasum	1.1%
Ketosis	1.2%
Mastitis	3.1%
Metritis	1.4%
Retained placenta	1.0%



CDCB Health Traits

As of August 2018, Net Merit $ includes the six health traits launched in April.

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Cost considerations

Event	Direct cost
MFEV	$34 (38 – 4)
DA	$197 (178 + 19)
KETO	$28 (28 + 0)
MAST	$75 (72 + 3)
METR	$112 (105 + 7)
RETP	$68 (64 + 4)

- Direct costs of each event used in development of HTH$
    - Considers veterinary and treatment costs
    - Excludes costs that are accounted for by other traits in NM$ (e.g., declines in fertility, decreased production)
- Yield traits designated as abnormal or “sick” test days are adjusted
    - These test days are accounted for with an additional adjustment (in parentheses above)

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Variance adjustments

- Linear model used with binary trait
- Phenotypic pre-adjustments applied to all health events
  - Phenotypes are adjusted based on calving year, parity, and heritability of the trait prior to genetic evaluation
- Similar to methodology described by Wiggans and VanRaden, 1992 and the adjustment applied to livability
- Implemented April 2019

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Variance adjustments

- Most health traits had PTA correlations ranging from 0.92 to 0.98 for bulls with > 70% REL born since 2000
  - Exception – milk fever
- For all traits – first lactation trends agreed with the new trends more closely than with the old trends.

Interbull validation

- MAST now sent along with SCS PTA to Interbull for Udder Health trait group
- Validation of genetic trends
- Only see on average a 1 point increase in reliability
- Minimal foreign bulls from countries supplying MAST directly that also have genotypes available in the US

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FUTURE PERSPECTIVES

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Future developments

(jerseyjournal.usjersey.com)

- Health evaluations for Jersey
  - Genomic evaluations for the 6 health traits
  - Reliability approximately 10-15 points lower than Holstein on average
  - See L. Jensen’s talk – ADSA Tuesday 10:30 AM Room 207/208

Future developments

- Multiple trait evaluations
  - Approximate genetic correlations
  - Mastitis & SCS
  - Groups of traits – metabolic, reproductive?

	Protein	PL	LIV	SCS	DPR	CCR	HCR
MFEV	-0.21*	-0.10	0.08	-0.02	-0.07	-0.08	-0.01
DA	0.15	0.40*	0.41*	-0.14	0.30*	0.30*	0.12
KETO	0.20*	0.39*	0.31*	-0.25*	0.41*	0.39*	0.19*
MAST	0.06	0.52*	0.39*	-0.68*	0.32*	0.31*	0.10*
METR	0.27*	0.47*	0.33*	-0.21*	0.44*	0.45*	0.29*
RETP	0.02	0.21*	0.16*	-0.13	0.19*	0.19*	0.19*

Potential health traits

- Continued investigation on economically important health traits
  - Lameness or locomotion
    - Events represent a variety of reasons for lameness – injury, conformation, metabolic, infection
    - How to differentiate between these?
  - Johne's

(https://vetextension.wsu.edu/research-projects/lameness/)

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Potential health traits

(https://hoards.com)

- Calf health & calf termination
  - Dairy calf death losses estimated at **$327.3 million** in 2015 (Lombard et al., 2019)
  - Possible to include calf/heifer health records with Format 6
  - Lombard et al., 2019 – proposed death loss categorization scheme
    - Pursuing Data Quality group of CDCB working with this scheme and termination reasons already collected by CDCB
    - Goal: expand termination codes to include calves/heifers

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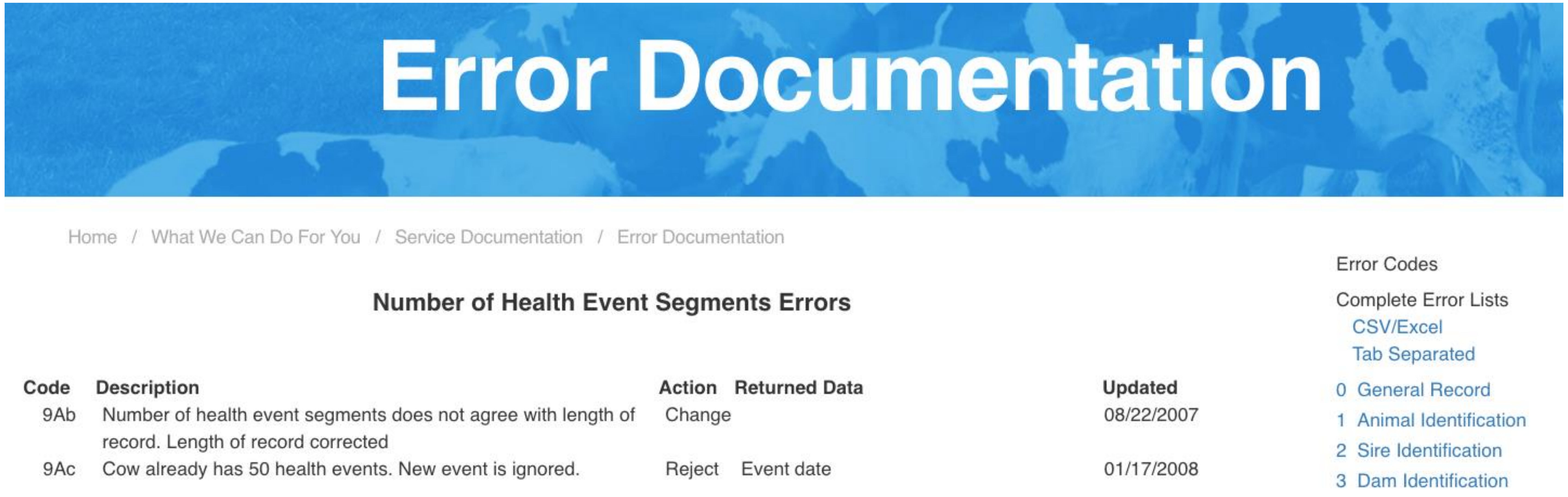
Maintenance of data pipelines

- Expand current pipelines to capture additional information
- Monitor data being submitted, accepted, and rejected
- Two-way communication with data providers
- Updates to standardization “dictionaries” as needed



Error Documentation

Home / What We Can Do For You / Service Documentation / Error Documentation

Number of Health Event Segments Errors

Code	Description	Action	Returned Data	Updated
9Ab	Number of health event segments does not agree with length of record. Length of record corrected	Change		08/22/2007
9Ac	Cow already has 50 health events. New event is ignored.	Reject	Event date	01/17/2008

Error Codes

Complete Error Lists
- CSV/Excel
- Tab Separated

- 0 General Record
- 1 Animal Identification
- 2 Sire Identification
- 3 Dam Identification

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New functional traits

- **Feed efficiency**
  - Project funded by Foundation for Food and Agriculture Research (FFAR) and CDCB
  - Institutions include Michigan State University, University of Wisconsin, Iowa State University, University of Florida, and USDA Animal Genomics and Improvement Laboratory
  - Continuing the work of USDA NIFA grant
  - Projected that breeding for more efficient dairy cows could save the U.S. dairy industry $540 million per year
  - Inclusion of feed efficiency in Net Merit $

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Creation of data pipelines

- New data types
  - E.g., feed intake data, sensor data
    - Different systems at various institutions
    - Protocol needs to be developed to streamline data processing
    - Need for standardization

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Evaluation sources

- Increasing number of similar evaluations from different sources
  - Published methodologies
    - Health $ (CDCB)
    - Clarifide Plus (Zoetis)
  - Proprietary evaluations / indices
    - TransitionRight index (ABS)
    - Better Life Health index (CRV)
    - Ideal Commercial Cow index (Genex)

Differing results

- Traits with limited data + low heritabilities
  - Different populations
  - Different editing
  - Different statistical model
  - Different presentation
  - Different economic assumptions

Handling multiple sources

- Producers have to consider the source of information
- Critical to not focus selection on only a few traits
- What does the future hold?

Continued progress

- More data available than ever before – making selection for new traits possible
- Continual improvement of available traits
- Phenotypes are critical
    - Establishment and maintenance of data pipelines
    - Quality control standards

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Acknowledgements

CDCB

AGIL

DRPCs, DRMS

Dairy producers

Thank You!

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